7A32

INSTRUCTION MANUAL

MODEL 103 M

PULSE GENERATOR

DATAPULSE

INSTRUCTION MANUAL

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PULSE GENERATOR

The DATAPULSE MODEL 103M Pulse Generator is a compact source of fast repetition rate pulses. When utilized with appropriate output units of the *P900 series the instrument features two-channel operation with each channel output independently variable in delay, width, amplitude, and pulse shape.

This manual provides detailed instructions for the use and maintenance of your Model 103M. A thorough understanding of its contents will contribute to full utilization and longer life of the instrument.

*The P 900 series (plug-in) output amplifiers offered for use in the 103 M are covered in separate instruction manuals which may be included in this manual.

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Model 103M Transistorized Pulse Generator

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SCHEMATICS

Drawing Number	Description
J40000-020	Schematic - Time Delay & Delay Trigger Forming Circuits
J40000-062	Schematic - Power Supply
J40000-019	Schematic - Multivibrator, Input Circuitry & Trigger Forming Circuit

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ADDENDA AND ERRATA*

DATAPULSE MODEL 103M
PULSE GENERATOR

E. O. NO.	RELEASE DATE	DRAWING NO.	CHANGE
821	1/18/66	J40000-062B	Schematic - Power Supply. Add ferrite bead (one) to emitter lead of Q23, Q63, and Q83.
830	1/26/66	J40000-062B	Schematic - Power Supply. Delete C64 and C84 (100 μf, 35v) and add to "omitted" block.

*Revised 1/20/66

SECTION I

SPECIFICATIONS

1.1 REPETITION RATE

Continuously variable from less than 5 cps to 5 mc, covered in 18 calibrated steps (1, 2, 5 series) with uncalibrated vernier. Step control accuracy is less than 10%. Stability* is better than 0.05%, jitter is less than 0.02%.

1.2 EXTERNAL TRIGGER

Requires 8v pos. pulse or neg. pulse with accessory inverting transformer, with less than 100 μsec rise time (50 nanosec minimum duration) at 0 to 5 mc, or 8v rms sine wave at 10 kc to 5 mc. Input impedance is approximately 1000 ohms, AC coupled.

1.3 SINGLE PULSE

Operation of front panel pushbutton provides one cycle of outputs.

1.4 GATED OPERATION

Outputs may be gated off by an external control level of pos. 5-15v, gated on at zero volts. Gate input impedance is approximately 1 K shunted by 100pf.

1.5 SYNC OUTPUTS

Pos. 8 to 10 K pulses from 100 ohm source impedance, approximately .05 μsec duration, AC coupled.

1.5.1 Reference Sync

Occurs once in each cycle as the reference for main pulse delays (delayed approximately 30 nanosec from external trigger if used).

1.5.2 Channel Two Sync

Occurs once in each cycle, variably delayed from the Reference Sync by the Channel Two Main Pulse Delay Control as specified below. May be used as a reference sync, with the Channel One delay set at minimum, to provide "advanced pulse" operation of the Channel One Main Pulse Output. Occurs approximately coincident with the leading edge of the Channel Two Main Pulse Output provided when two plug-in output units are used.

1.6 MAIN PULSE DELAYS (of Model 103 triggers to plug-in output units with respect to reference sync — main pulse output leading edge delays are slightly increased by the inherent triggering delay specified for each output unit)

Separately variable for Channels One and Two, continuously from less than 0.1 μsec to 5 millisec, covered in 14 calibrated steps (1, 2, 5 series) plus uncalibrated vernier control. Main pulse output separation, when used as a double pulse generator, is continuously variable over the range ±5 millisec. Step control accuracy is approximately 10%. Stability* better than ±0.05%, jitter is less than 0.02%.

1.7 MAIN PULSE OUTPUT

Any P900 series plug-in output unit may be used, with one unit required for single pulse generation and two units for double pulse operation. Output characteristics are determined by the output units selected.

1.8 POWER REQUIRED

105-125v 50/60 cycle AC, approximately 50 watts, 220v 50/60 cycle operation may be specified at no added cost.

1.9 CONSTRUCTION

Brushed aluminum front panel with etched black and red markings, beige cabinet with quick release top and bottom covers, forced air cooling with filter, provision for plugging in two P900 series output units. All signal connectors are BNC type.

1.10 SIZE AND WEIGHT

5-1/4" h x 17" w x 16-1/2" d. May be rack mounted (5-1/4" x 19" panel space) by specifying Model 103MR, or by installing accessory Type 1003 Rack Mounting Set. Weight is approximately 25 lbs (without plug-in output units).

1.11 ACCESSORIES FURNISHED

One operation and maintenance manual, 8 ft. line cord with NEMA 3 prong plug.

1.12 ACCESSORIES AVAILABLE

P900 Series Output Units, mixer (Type 2302 for P906 unit); 50 ohm, 25 w, power termination (Type 2003); 50 ohm, 50 w power termination (Type 2004); trigger pulse inverting transformer (Type 2101); coaxial cables, connector adapters.

*Stability is specified as variation over ±10% line voltage change from 115 vac.

SECTION II

OPERATING INSTRUCTIONS

2.1 DESCRIPTION OF CONTROLS AND CONNECTORS

2.1.1 Repetition Rate-Vernier

This control is used to select the output pulse repetition rate. The vernier control allows the calibrated rate to be decreased up to a factor of approximately one-third.

2.1.2 Single Pulse

Depression of this button when the repetition rate switch is on EXT. causes one cycle of outputs to occur.

2.1.3 Pos. External Trigger Input

A positive pulse (see Section I, Par. 1.2) applied through this BNC connector will cause an output pulse to occur. A reference sync output will occur after approximately .05 microsec delay.

2.1.4 Pos. Ext. Gate Input

This BNC connector accommodates the external gating signal. When the dc level of this signal is +5 volts, the generator output signals are shut off. They are gated on when the signal drops to zero volts.

2.1.5 Positive Sync Outputs

See Section I, Par. 1.6 for pulse waveshape.

2.1.5.1 Channel 2. A timing pulse occurs at this output approximately coincident with the leading edge of the Channel 2 output pulse.

2.1.5.2 Reference. A pulse occurs at this output which serves as a zero time reference for the main pulse delay.

2.1.6 Pulse Delay - Vernier (Both Controls)

This control is used to select the output pulse delay from the reference sync pulse. The vernier control allows the calibrated delay to be decreased up to a factor of approximately one-third.

2.2 PLACING IN OPERATION

Insert the plug-in units to be used, pressing firmly to insure that connectors make proper contact. Tighten the locking mechanisms. Connect the power cord to the rear of the instrument and to the power line and turn the POWER switch to the ON position.

NO pulse delay or pulse duration switch should be set such that the output pulse spacing is less than twice their setting.

2.3 OPERATING CONSIDERATIONS

CAUTION

2.3.1 External Trigger and Gate Inputs

A voltage transient in excess of 50 volts is to be avoided due to probable damage to the input transistors.

2.3.2 230-Volt Operation

The Model 103M is normally wired for use with a 115v power source. To convert it for use with a 230v source, change the dual primary windings of the power transformer from a parallel combination to a series configuration. (See schematic diagram for details.) When making this change, the line fuse located on the rear of the instrument should be replaced with one of half its value.

2.4 SPECIAL APPLICATIONS

2.4.1 Pulse Advance Operation

Using the Channel 2 sync output as a reference, Channel 1 may be effectively advanced by an amount equal to the difference of the two delays (i.e., Channel 1 output may be either advanced or delayed from Channel 2 output from zero to 5 milliseconds.)

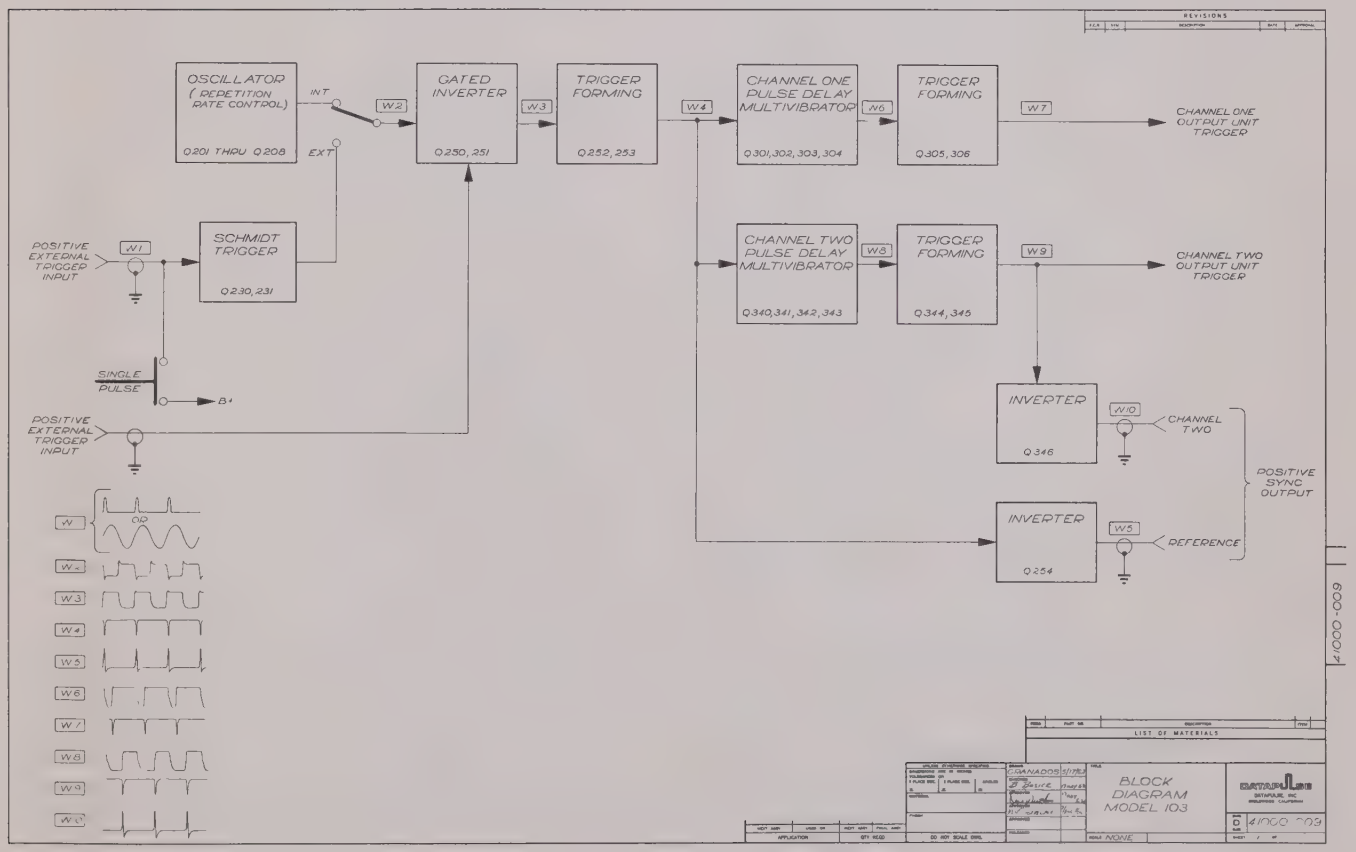
SECTION III

THEORY OF OPERATION

3.1 BLOCK DIAGRAM DESCRIPTION (Refer to Block Diagram and Schematic Diagrams)

A square wave is generated by an astable multivibrator (Q201 - Q208) or by a Schmitt trigger (Q230, 231) when the 103M is externally triggered. This square wave is fed through an inverter which may be gated off through the use of an external positive dc level. The positive going edge of the square wave is shaped into a 20-nanosec wide, negative 2-volt pulse by a trigger forming circuit (Q252, Q253). This negative pulse triggers both pulse delay multivibrators, and is offered as a positive sync pulse for reference purposes, after being amplified by Q254.

The operation of both delay multivibrators is identical. The variable width pulse formed by the multivibrators is differentiated and the trailing edge formed into a negative 2-volt pulse, 20-nanosec wide for use in triggering an appropriate P900 series output unit. The Channel 2 delayed trigger is also amplified by Q346 and offered as a delayed sync output.



SECTION IV

MAINTENANCE INSTRUCTIONS

4.1 PREVENTIVE MAINTENANCE

4.1.1 Cooling

The Model 103M utilized a forced-air cooling system to maintain tolerable temperatures within the unit. It is important that the covers supplied with the unit be kept in place during operation.

The air intake and filter are located at the rear of the instrument. For proper ventilation, maintain at least three inches of clearance about the rear of the unit and be sure no other instruments discharge hot air into the air intake.

Inspect the filter regularly and clean it before it becomes dirty enough to restrict air flow. Clean and restore filter as follows:

1. Remove filter from instrument and wash it in warm water and detergent.
2. Dry filter thoroughly and coat it with a filter adhesive such as Filter Coat #3, made by Research Products Company, Inc. This adhesive comes in convenient spray cans and is available from most heating supply stores.

4.1.2 Recalibration

The Model 103M is a very stable instrument and will provide many hours of trouble-free operation. To insure continued reliability, the power supply, time base and delay circuits should be checked for calibration after each 500 hours of operation, or at least every six months if the unit is used intermittently.

4.1.3 Visual Inspection

Perform a complete visual inspection at regular intervals, preferably once a month. Inspect for loose or broken connections; damaged binding posts; scorched printed circuit boards, wires or resistors; and loose nuts and bolts.

For most visual troubles, the remedy is apparent; however, particular care must be taken when heat-damaged components are detected. Overheating of parts is often the result of other, less apparent defects in the circuit.

4.1.4 Component Replacement and Soldering Considerations

When replacing transistors, diodes, or other heat-sensitive devices, a heat sink should be used between the device and the soldering iron tip. A pair of long-nosed pliers may be used in most cases.

Special care must be taken when soldering printed circuit wiring to avoid overheating and subsequent separation of the printed circuit from its epoxy material.

4.1.5 Power Cable

The three-conductor power cable supplied with this instrument is terminated in a polarized three-prong male connector as recommended by the National Electrical Manufacturer's Association. The third contact is an offset round pin which is added to a standard two-blade connector and grounds the instrument chassis when used with an appropriate receptable.

WARNING

An adapter should be used to connect the NEMA plug to a standard two-contact output. When the adapter is used, the ground connection terminates in a short green lead which should be connected to a suitable ground for the protection of operating personnel.

4.1.6 Removal of Dust Covers

The dust covers are held in place by small screw-head fasteners. To remove, turn the fasteners a quarter turn counterclockwise with a common screw-driver. To remove the top dust cover: (1) loosen the fasteners in the sides of the bottom dust cover; (2) remove the four fasterners on the sides of the top dust cover; (3) loosen the two fasteners on the top of the top dust cover; and (4) lift the cover up and off.

4.2 TROUBLESHOOTING PROCEDURE

Before attempting to troubleshoot the instrument, make sure that the trouble is actually due to a malfunction within the instrument and not to improper control settings or a faulty plug-in unit. The plug-in units may be replaced with others known to be in good condition. If the trouble is still apparent, it is almost a certainty that the 103M is at fault.

Photographic details of various assemblies are shown in this manual. These are provided as parts location guides.

4.2.1 Equipment Required

DC oscilloscope - Tektronix 541, Hewlett-Packard 150A or equivalent.

DC voltmeter - Any voltmeter with greater than 1000 ohms-per-volt sensitivity, calibrated to ±5%.

4.2.2 Isolating the Trouble

The first circuit to check after most malfunctions is the system power supply, +10v, -10v and -5v; do not proceed before these voltages are properly adjusted.

When troubleshooting the 103M, it is useful to consider the instrument as several basic circuits as shown in the block diagram.

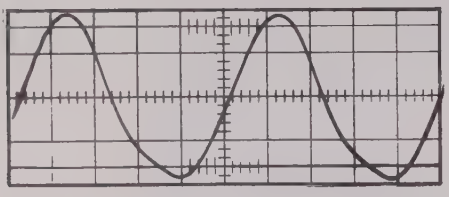
Utilizing this drawing with accompanying waveforms, one may isolate the general area of trouble. Once the area is isolated, the schematic diagrams in this manual may be used to locate the defective components.

Refer to the characteristic waveforms section of this manual for further aid in typical waveshapes to be found.

TABLE 4-1. CHARACTERISTICS WAVEFORM

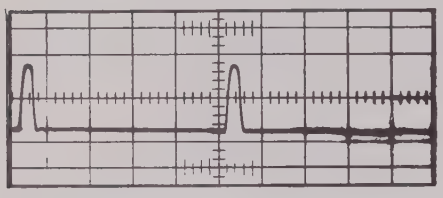
The waveforms shown here should prove useful during troubleshooting. These photographs were taken with a Tektronix Type 581 Oscilloscope with a Type CA dual trace plug-in unit. Waveform numbers correspond to those on the block diagram. Settings: 0.2μs/cm, 2.0v/cm, except W1 is 5v/cm and W2 is 1v/cm.

W1



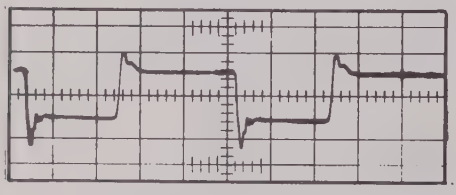
Ext. Sine Wave Input

W1



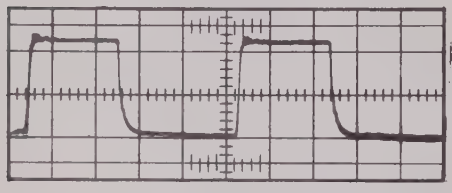
Ext. Pulse Input

W2



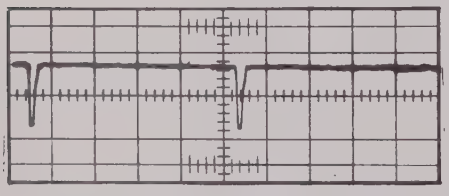
Gated Inverter Input

W3



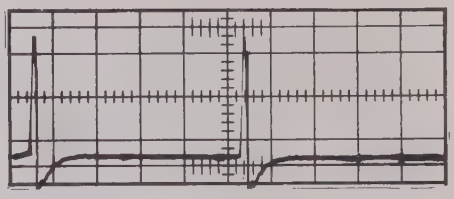
Gated Inverter Output

W4



Trigger for Delay Circuits and Reference Sync Output

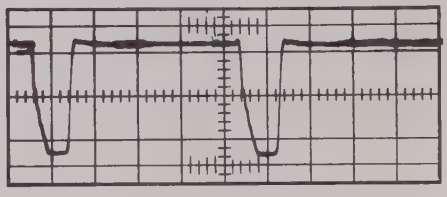
W5



gnd

Pos. Reference Sync Output

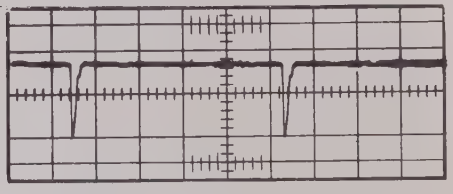
W6



gnd

Channel One Delay Circuit Output

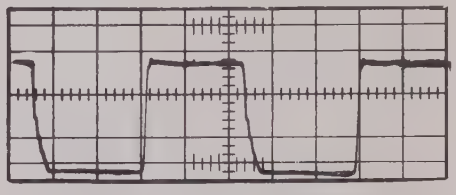
W7



gnd

Channel One Output Unit Trigger

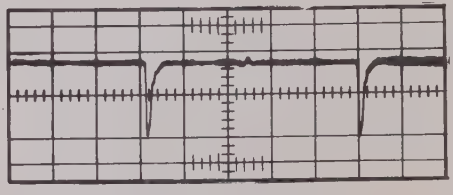
W8



gnd

Channel Two Delay Circuit Output

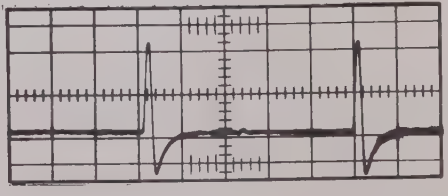
W9



gnd

Trigger for Channel Two Delay Circuit and Channel Two Sync Output

W10



gnd

Channel Two Pos. Sync Output

4.3 CALIBRATION PROCEDURE

4.3.1 Equipment Required

DC oscilloscope - Tektronix 541, Hewlett-Packard 150A or equivalent.

DC voltmeter - Any voltmeter with greater than 1000 ohms-per-volt sensitivity, calibrated to ±5%.

4.3.2 Power Supply

If the power supply voltages are out of specified calibration, adjustment can be made from the bottom of the power supply printed circuit board. The adjustment sequence which must be used is as follows:

1. +10v
2. -10v
3. -5v

4.3.3 Repetition Rate

The repetition rate calibration adjustments are located on the bottom of the instrument, labeled OSC.

Set the REPETITION RATE switch to 50 KC/S, turn the VERNIER control fully clockwise and leave it there throughout the rest of the calibration.

Observing the REFERENCE sync output, adjust the control labeled "50 KC" for correct pulse spacing (20 microsec).

Set the REPETITION RATE switch to 0.1 MC/S and adjust the control labeled "0.1 MC" for correct pulse spacing (10 microsec).

Set the REPETITION RATE switch to 0.2 MC/S and adjust the control labeled "0.2 MC" for correct pulse spacing (5 microsec).

No further repetition rate calibration should be necessary; however, there are trimmer condensers on the top side of the REPETITION RATE switch to adjust the 1 MC/S, 2 MC/S and 5 MC/S ranges if further calibration accuracy is desired on these ranges.

4.3.4 Pulse Delay (Either Channel 1 or Channel 2)

The pulse delay calibration adjustments will be found on the underneath side of the instrument, labeled CHAN 1 DLY and CHAN 2 DLY.

Trigger your syncroscope with the REFERENCE sync output and observe its position on the scope face. All pulse delay measurements will be made from the 50% amplitude point on the leading edge of this pulse, to the 50% point on the leading edge of the pulse generated by the output unit being used.

If the output unit used has a variable rise and fall time feature, these times should be set for minimum.

Set REPETITION RATE control on 50 KC/S.

Set the Pulse Delay control to 1 microsec and turn the Vernier fully clockwise. Leave it there throughout the rest of the calibration.

Observe the output pulse delay from REFERENCE sync time and adjust the 1 μsec calibration control for 1 microsec delay.

Set the Pulse Delay control to 2 microsec and adjust the 2 μsec calibration control for 2 microsec delay.

Set the Pulse Delay control to 5 microsec and adjust the 5 μsec calibration control for 5 microsec delay.

No further delay calibration should now be necessary; however, there are trimmer condensers on the top side of the pulse delay switches to adjust the .5 microsec and .2 microsec ranges if further calibration accuracy is required on these ranges.

This concludes the 103M calibration, for calibration of pulse widths refer to the instruction manual for the output unit being used.

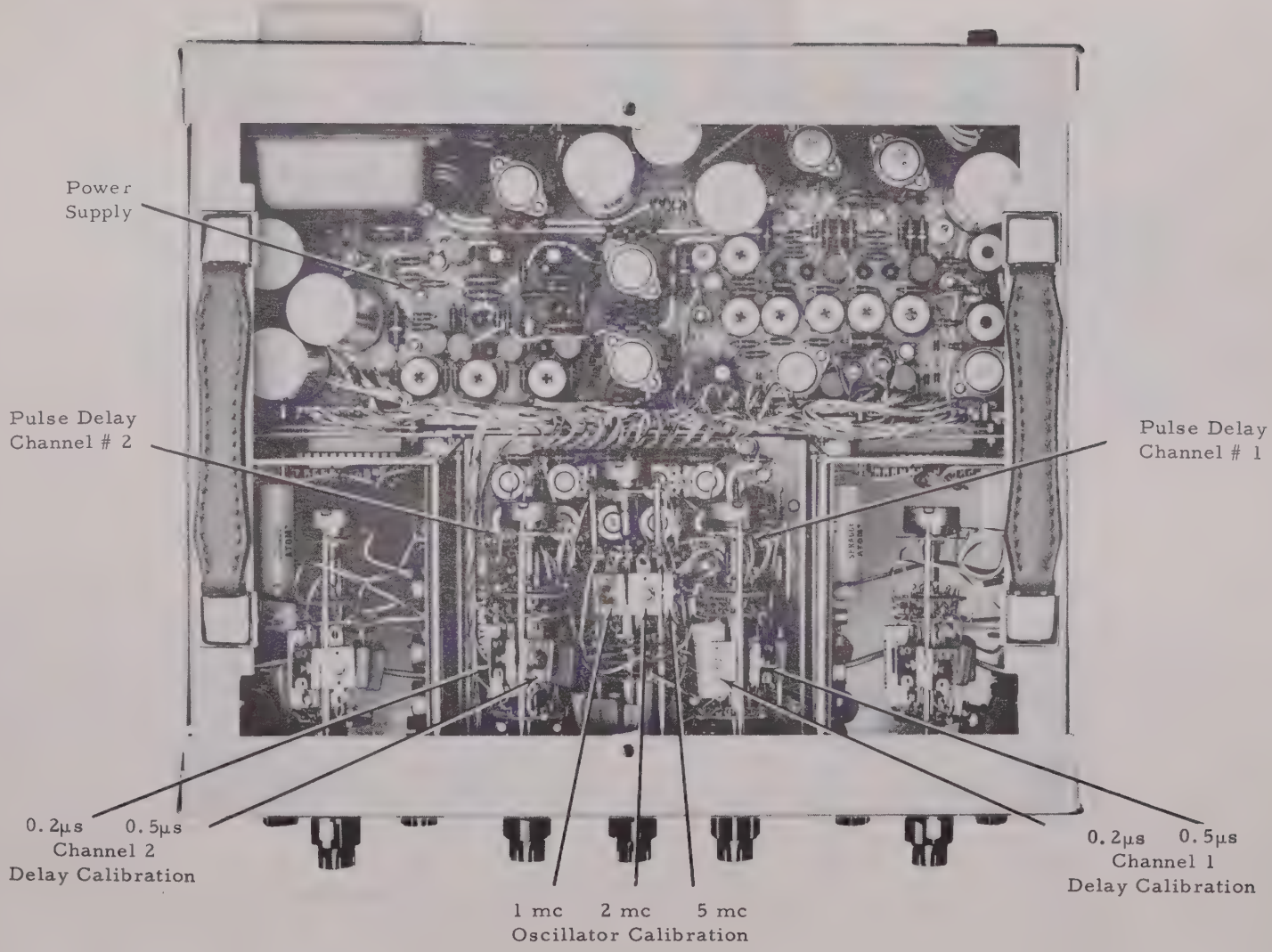


Figure 4-1. Model 103M Viewed from Top

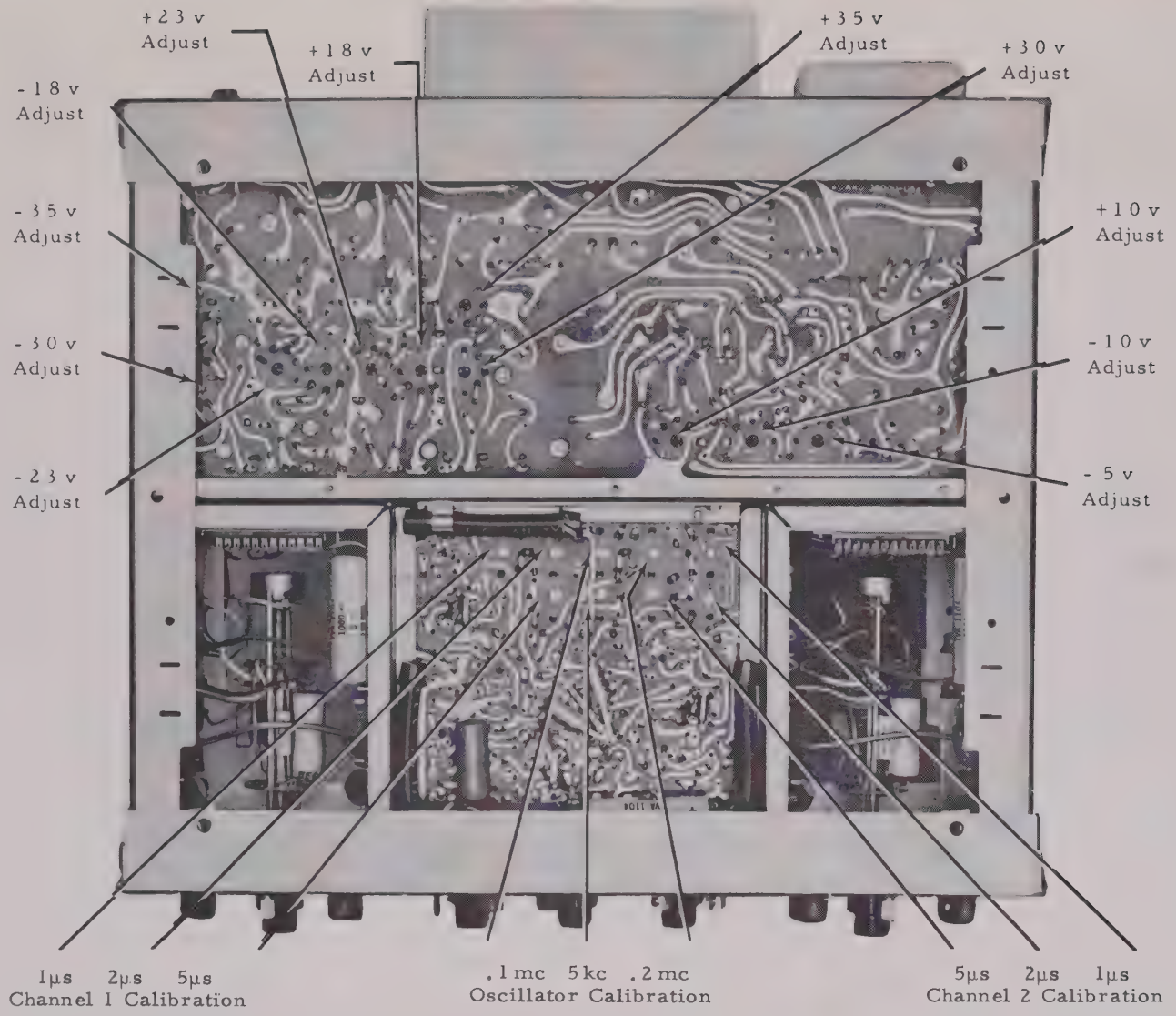


Figure 4-2. Model 103M Viewed from Bottom

PARTS LIST

5.1 HOW TO USE THIS PARTS LIST

5.1.1 Reference Designations

Reference designations used throughout this listing correspond with reference designations given on component location photos and the following schematics:

Drawing No. J40000-019
Drawing No. J40000-020
Drawing No. J40000-062

Resistors are designated as R1, R2, R3, etc, and are fixed value, composition, 10%, and 1/2 w unless otherwise noted.

Capacitors are designated as C1, C2, C3 etc., and are fixed value, 10% and 500v DC unless otherwise noted.

Diodes are designated as CR1, CR2, CR3; switches as S1, S2, S3; inductors as L1, L2, and L3; Transistors are Q1, Q2, Q3, etc.

5.1.2 Abbreviations

The following abbreviations are used:

CER:	Ceramic
DPC:	Deposited Carbon
ELECT.	Electrolytic
M:	Mica
GMV:	Guaranteed Min. Value
OF:	Oil Filled
PT:	Paper Tubular
SM:	Silver Mica
VAR:	Variable
WW:	Wire Wound
PNP:	Positive-Negative-Positive
NPN:	Negative-Positive-Negative
µsec:	Microsecond
µf:	Microfarad
ns:	Nanosecond
ms:	Millisecond
MP:	Metalized Paper
TANT:	Tantalum
PIV:	Peak Inverse Voltage
PC:	Printed Circuit
Germ:	Germanium
SPDT:	Single Pull Double Throw

5.1.3 Federal Manufacturers Code Numbers

Manufacturers of the components used in this instrument are referenced herein by Federal Supply Code numbers as listed below:

Company	Federal Code Number
Allen-Bradley	01121
Chicago Telephone	71450
General Radio	24655
Ward Lenard	06136
Sangamo	00853
MEC Inc.	None
Cornell Dublier	09023
Electro Cube	14752
Sprague	56289
Arco	02799
Comark	None
Erie	91674
Motorola	94990
Texas Instruments, Inc.	01295
Philco	98329
General Instrument	14936
Alco	95146
Centralab	71590
PCA	None
Drake	72765
ACDC	08742
Bushman	71400
Corning	07115
Melrain	08984
Magnetic Components	14831
Hughes Aircraft, SC Div.	73293
Nashville Electronics	None
Sylvania Electric	93332
Radio Corp. of America	02735
Fairchild Semiconductor	07263
General Electric	03508
Mallory	37942
Hoffman Semiconductor	99942
Technitrol Engineering	90095
Elco	91662
Wilco	99818
Oak	81716
Lafayette Radio	75491
Pacific Semiconductors	01281
Datapulse Incorporated	15933
Elmenco Products	04062
Capco Corporation	04099
Texas Capacitor	09134
Switchcraft Inc.	82389
Ohmite Mfg. Company	03615
General Instruments	91719
Wilco Company	79327
Beckman Instruments	80740

PARTS LIST

5.2 DELAY SWITCH ASSEMBLY

REF. NO.	QTY. USED	DESCRIPTION	DATAPULSE PART NO.	FEDERAL MFRS. CODE NO.	MFRS. PART NO.
5.2.1	Resistors				
R314	1	1K, 2w, 20%, Var.	20053-102	01121	
R323	1	3.6K, 5%	10011-362	01121	EB3625
5.2.2	Capacitors				
C302	1	1.0 µf, 100v, 1%	11093-105		
C303	1	0.1 µf, 100v, 1%, VTQ	11093-104	56289	
C304	1	.01 µf, 300v, 1%, S.M.	11025-103	00853	
C305	1	1000 pf, 1%, S.M.	11027-102	00853	
C306	2	2.7 to 300 pf, 175v, Var. M.	11313-300	02799	461
C307	1	68 pf, 5%	11017-680	00853	
C309		Same as C306			
5.2.3	Switches				
S301	1	Rotary, 14 pos., 3 Pole, Shorting	25250-007	81716	

PARTS LIST

5.3 OSCILLATOR SWITCH ASSEMBLY

REF. NO.	QTY. USED	DESCRIPTION	DATAPULSE PART NO.	FEDERAL MFRS. CODE NO.	MFRS. PART NO.
5.3.1		Resistors			
R202	1	5.1K, 5%	10011-512	01121	EB5125
R203	1	15K, 5%	10011-153	01121	EB1535
R212	1	1K, 2w, 20%, Var.	20053-102	01121	
5.3.2		Capacitors			
C202	2	47 pf, 5%, S.M.	11017-470		
C203	1	100 pf, 5%, S.M.	11017-101		
C204	2	1000 pf, 1%, S.M.	11027-102		
C205	2	.01 µf, 300v, 1%, S.M.	11025-103		
C206	2	0.1 µf, 100v, 1%, VTQ	11093-104	56289	
C207	2	1.0 µf, 100v, 1%	11093-105		
C208	2	10 µf, 25v, Tant.	11511-106		
C209	3	4 to 30 pf, 175v, M.	11307-300	02799	461
C210	1	27 pf	11017-270		
C211		Same as C209			
C212		Same as C202			
C213		Same as C209			
C214	1	82 pf, 5%, S.M.	11017-820		
C215		Same as C204			
C216		Same as C205			
C217		Same as C206			
C218		Same as 207			
C219		Same as C208			
5.3.3		Switches			
S201		Rotary, 20 pos., 4 sec., Shorting	25250-020	81716	

PARTS LIST

5.4 POWER SUPPLY P.C. BOARD ASSEMBLY

REF. NO.	QTY. USED	DESCRIPTION	DATAPULSE PART NO.	FEDERAL MFRS. CODE NO.	MFRS. PART NO.
5.4.1	Resistors				
R2 and R3	12	1K	10021-102	01121	EB1021
R4	12	470 Ω	10021-471	01121	EB4711
R5	7	2.7 Ω, 1w	10022-279	01121	GB27G1
R6	2	2.2K	10021-222	01121	EB2221
R7	1	100 Ω, 1w	10022-101	01121	GB1011
R8		Same as R4			
R9	11	500 Ω, 2w, 20%, Var. WWPC	10493-501	08984	HHH-2
R10		Same as R4			
R20	1	1 Ω, 10w, 5%, WW	10305-100	06136	10F1WL
R21 and R22		Same as R2			
R23		Same as R4			
R24		Same as R6			
R25 and R26		Same as R5			
R27		Same as R4			
R28		Same as R9			
R29		Same as R4			
R38		Same as R4			
R40	1	22 Ω, 2w	10023-220	01121	HB2201
R41		Same as R4			
R42		Same as R9			
R43		Same as R4			
R44		Same as R2			
R45	1	3.3K	10021-332	01121	EB3321
R46	1	330 Ω	10021-331	01121	EB3311
R47	3	100 Ω	10021-101	01121	EB1011
R48		Same as R2			
R61		Same as R2			
R62	2	1K, 1w	10022-102	01121	GB1021
R63		Same as R47			
R68		Same as R4			
R69		Same as R9			
R70		Same as R4			
R71		Same as R2			
R72		Same as R9			
R73	1	150 Ω	10021-151	01121	EB1511
R74	2	100 Ω, 10w, 5%, WW	10305-101	06136	10F100WL
R75 and R76		Same as R5			
R77	4	390 Ω	10021-391	01121	EB3911

PARTS LIST

REF. NO.	QTY. USED	DESCRIPTION	DATAPULSE PART NO.	FEDERAL MFRS. CODE NO.	MFRS. PART NO.
5.4.1		Resistors (continued)			
R78	4	4.7K	10021-472	01121	EB4721
R81		Same as R2			
R82		Same as R62			
R83		Same as R47			
R89		Same as R9			
R90		Same as R4			
R91		Same as R9			
R92		Same as R2			
R93	1	470 Ω, 2w	10023-471	01121	HB4711
R94		Same as R74			
R95 and R96		Same as R5			
R97		Same as R77			
R98		Same as R78			
R100	3	100 Ω, 2w	10023-101	01121	HB1011
R101		Same as R9			
R102	2	1.5K	10021-152	01121	EB1521
R103		Same as R78			
R104		Same as R9			
R105		Same as R77			
R107		Same as R2			
R108	2	150 Ω, 10w, 5%, WW	10305-151	06136	10F150WL
R120		Same as R100			
R121		Same as R9			
R122		Same as R102			
R123		Same as R78			
R124		Same as R9			
R125		Same as R77			
R126		Same as R100			
R127		Same as R2			
R128		Same as R108			

PARTS LIST

5.4 POWER SUPPLY P.C. BOARD ASSEMBLY

REF. NO.	QTY. USED	DESCRIPTION	DATAPULSE PART NO.	FEDERAL MFRS. CODE NO.	MFRS. PART NO.
5.4.2		Capacitors			
C1 and C2	2	.1 µf, 400v, Mylar	11066-104	02799	4DP-3-104
C4	7	1500 µf, 50v, Elect.	11162-158	00853	PLP-1500-50V
C5 and C6	9	100 µf, 35v, Elect.	11162-107	Nashville	20-500BP/100-35S85
C20 and C21		Same as C4			
C22 and C23		Same as C5			
C41		Same as C5			
C60		Same as C4			
C61 and C62		Same as C5			
C63	2	.1 µf, 75v, CER Disc.	11242-104	71590	DDA-104
C80		Same as C4			
C81 and C82		Same as C5			
C83		Same as C63			
C100		Same as C4			
C120		Same as C4			

PARTS LIST

5.4 POWER SUPPLY P.C. BOARD ASSEMBLY

REF. NO.	QTY. USED	DESCRIPTION	DATAPULSE PART NO.	FEDERAL MFRS. CODE NO.	MFRS. PART NO.
5.4.3		Transistors			
Q1	7	Germ., PNP, 5 amp.	12455-008	94990	2N1535
Q2	7	Silicon PNP, To-5	22595-000	15933	59-0
Q3 and Q4	8	Silicon PNP	12605-005	07263	2N3638
Q20		Same as Q1			
Q21		Same as Q2			
Q22 and Q23		Same as Q3			
Q40 and Q41	2	Silicon, NPN, To -18	22635-004	15933	63-4
Q42		Same as Q2			
Q43		Same as Q1			
Q60		Same as Q1			
Q61		Same as Q2			
Q62 and Q63		Same as Q3			
Q64		Same as Q1			
Q80		Same as Q1			
Q81		Same as Q2			
Q82		Same as Q3			
Q83		Same as Q3			
Q84		Same as Q2			
Q100 and Q101	2	Silicon, NPN, Med. Power to -5	12695-001	94990	2N2270
Q120		Same as Q1			
Q121		Same as Q2			

PARTS LIST

5.4 POWER SUPPLY P.C. BOARD ASSEMBLY

REF. NO.	QTY. USED	DESCRIPTION	DATAPULSE PART NO.	FEDERAL MFRS. CODE NO.	MFRS. PART NO.
CR1	27	Silicon, PIV	22194-001	15933	19-1
CR2		Same as CR1			
CR3	1	Zener, 5.6v, 1w, 10%	12154-032		LMZX5.6
CR20 and CR21		Same as CR1			
CR61 thru CR63		Same as CR1			
CR64	1	Zener, 10v, 1w, 5%	12154-022	37942	ZA10B
CR80 thru CR83		Same as CR1			
CR100 thru CR103		Same as CR1			
CR104	2	Zener, 15v, 10w,	12156-003	99942	1N2979R or 1N1606
CR106 thru CR108		Same as CR1			
CR120 thru CR123		Same as CR1			
CR124		Same as CR104			
CR125 thru CR128		Same as CR1			

5.4 5 Miscellaneous

	2	Connector, 24 Pin, Blue Ribbon	15050-004	Amphenol	26-190-24

PARTS LIST

5.5 FRONT PANEL ASSEMBLY

REF. NO.	QTY. USED	DESCRIPTION	DATAPULSE PART NO.	FEDERAL MFRS. CODE NO.	MFRS. PART NO.
5.5.1		Switches			
	1	Toggle, SPDT, Sub. Min.	15280-001	95146	MST115D
	1	Push Button	15300-001	82389	903
5.5.2		Miscellaneous			
	1	Lamp, NE2H, Red with Nut	15450-002	72765	H116-323 RED
	2	Pulse Delay Switch Assembly	37000-053		
	1	Oscillating Switch Assembly	37000-054		

PARTS LIST

5.6 TIMING CIRCUIT PC BOARD ASSEMBLY

REF. NO.	QTY. USED	DESCRIPTION	DATAPULSE PART NO.	FEDERAL MFRS. CODE NO.	MFRS. PART NO.
5.6.1		Resistors			
R1		100K, Long Leads	10021-104	01121	EB1041
R201	1	5.1K, 5%	10011-512	01121	EB5125
R204	1	25K, .2w, 30%, Var.	20240-253	71450	Series UPE70
R205	2	15K	10021-153	01121	EB1531
R206	1	10K, .2w, 30%, Var.	20240-103	71450	Series UPE70
R207	1	6.8K	10021-682	01121	EB6821
R208	5	5K, .2w, 30%, Var.	20240-502	71450	Series UPE70
R209	11	3.3K	10021-332	01121	EB3321
R210	14	470 Ω	10021-471	01121	EB4711
R211	12	1K	10021-102	01121	EB1021
R213		Same as R210			
R214		Same as R209			
R215	7	220 Ω	10021-221	01121	EB2211
R216 and R217	6	47 Ω	10021-470	01121	EB4701
R218 and R219		Same as R210			
R220 and R221		Same as R216			
R222		Same as R210			
R223		Same as R215			
R224		Same as R209			
R225		Same as R211			
R226	4	47K	10021-473	01121	EB4731
R227		Same as R205			
R228		Same as R209			
R229 and R230	6	2.2K	10021-222	01121	EB2221
R240		Same as R229			
R241		Same as R211			
R242		Same as R229			
R243	1	3.3K, 5%	10011-332	01121	EB3325
R244	1	8.2K, 5%	10011-822	01121	EB8225
R245		Same as R216			
R246	1	600 Ω	10021-681	01121	EB6811
R247		Same as R215			
R248		Same as R209			
R249	1	4.7K	10021-472	01121	EB4721
R250	2	10K	10021-103	01121	EB1031
R251		Same as R210			

PARTS LIST

REF. NO.	QTY. USED	DESCRIPTION	DATAPULSE PART NO.	FEDERAL MFRS. CODE NO.	MFRS. PART NO.
5.6.1		Resistors (continued)			
R260		Same as R211			
R261		Same as R209			
R262		Same as R216			
R263		Same as R250			
R264		Same as R215			
R265		Same as R209			
R266		Same as R226			
R267 and R268		Same as R210			
R269	3	100 Ω	10021-101	01121	EB1011
R270		Same as R211			
R271	2	27K	10021-273	01121	EB2731
R272	2	100 Ω, 2w	10023-101	01121	EB1011
R301		Same as R211			
R302		Same as R210			
R303	2	1.5K	10021-152	01121	EB1521
R304		Same as R209			
R305		Same as R211			
R306	2	1K, .2w, 30%, Var.	20240-102	71450	Series UPE70
R307	6	330 Ω	10021-331	01121	EB3311
R308		Same as R208			
R309		Same as R229			
R310		Same as R208			
R311		Same as R211			
R312		Same as R210			
R313		Same as R269			
R315		Same as R307			
R316		Same as R209			
R317		Same as R226			
R318	2	270 Ω	10021-270	01121	EB2701
R319		Same as R210			
R320		Same as R215			
R321	2	33 Ω	10021-330	01121	EB3301
R322		Same as R307			
R340		Same as R211			
R341		Same as R210			
R342		Same as R303			
R343		Same as R209			
R344		Same as R211			
R345		Same as R306			
R346		Same as R307			
R347		Same as R208			
R348		Same as R229			
R349		Same as R208			
R350		Same as R211			
R351		Same as R210			
R352		Same as R269			
R354		Same as R307			

PARTS LIST

REF. NO.	QTY. USED	DESCRIPTION	DATAPULSE PART NO.	FEDERAL MFRS. CODE NO.	MFRS. PART NO.
5.6.1		Resistors (continued)			
R355		Same as R209			
R356		Same as R226			
R357		Same as R318			
R358		Same as R210			
R359		Same as R215			
R360		Same as R211			
R361		Same as R271			
R362		Same as R272			
R363		Same as R321			
R364		Same as R307			

PARTS LIST

5.6 TIMING CIRCUIT P.C. BOARD ASSEMBLY

REF. NO.	QTY. USED	DESCRIPTION	DATAPULSE PART NO.	FEDERAL MFRS. CODE NO.	MFRS. PART NO.	REC
5.6.2		Capacitors				
C220	6	0.1 µf, 75v, -20%, +80%, CER.	11242-104	71590	DDA-104	
C221 and C222	2	1.0 µf, 50v, -20%, +65%, Elect.	11152-105	MEC	EG8-1-50P	
C223	13	100 pf, 5%, S.M.	11017-101	00853	RR1310	
C224		Same as C220				
C225	1	1000 µf, 15v, Elect.	11150-108	56289	TVA-1104	
C226	3	10 µf, 20v, Tant.	11511-106	56289	150D-106X-9020B2	
C240 and C241	2	0.5 µf, 200v, Mylar	11064-504	02799	ZDP-5-504	
C242 and C243		Same as C223				
C260 and C261		Same as C223				
C262		Same as C220				
C263		Same as C223				
C264		Same as C220				
C265	2	220 uuf, 5%, S.M.	10017-221	00853	RR1322	
C301		Same as C223				
C310		Same as C223				
C311		Same as C220				
C312		Same as C223				
C313		Same as C226				
C314	2	100 µf, 12v, Elect.	11151-10T	09023	NLW100-12	
C340		Same as C223				
C349		Same as C223				
C350		Same as C220				
C351		Same as C223				
C352		Same as C314				
C353		Same as C223				
C354		Same as C265				
C355		Same as C226				

PARTS LIST

5.6 TIMING CIRCUIT P.C. BOARD ASSEMBLY

REF. NO.	QTY. USED	DESCRIPTION	DATAPULSE PART NO.	FEDERAL MFRS. CODE NO.	MFRS. PART NO.
5.6.3		Transistors			
Q201	3	Ger., PNP	22595-000	15933	59-0
Q202	19	Ger., PNP	22465-000	15933	46-0
Q203 and Q204	4		22465-001	15933	46-1
Q205 and Q206		Same as Q202			
Q207 and Q208	2		22605-003	15933	60-3
Q230 and Q231		Same as Q202			
Q250 thru Q254		Same as Q202			
Q301		Same as Q203			
Q302		Same as Q202			
Q303		Same As Q202			
Q304		Same as Q201			
Q305 and Q306		Same as Q202			
Q340		Same as Q203			
Q341		Same as Q202			
Q342		Same as Q202			
Q343		Same as Q201			
Q344 thru Q346		Same as Q202			

PARTS LIST

5.6 TIMING CIRCUIT P.C. BOARD ASSEMBLY

REF. NO.	QTY. USED	DESCRIPTION	DATAPULSE PART NO.	FEDERAL MFRS. CODE NO.	MFRS. PART NO.
5.6.4		Diodes			
CR201 and CR202	12	Silicon	22164-000	15933	16-0
CR203	1	Zener, 5.6v, 1w, 10%	12154-000	14936	1N1520
CR240		Same as CR201			
CR250		Same as CR201			
CR261 and CR262		Same as CR201			
CR301 and CR302		Same as CR201			
CR304		Same as CR201			
CR305	2	Zener, 5.1v, 5%, 400 mw	12154-002	01295	IN751A
CR340		Same as CR201			
CR341		Same as CR201			
CR343		Same as CR201			
CR344		Same as CR305			
5.6.5		Miscellaneous			
	3	Component Holders	15420-200	Atlee	100-200-16-27
DL260	3	Delay Line, 1000Ω, 3", RG65U (.015 us)	30000-005		
DL301		Same as DL260			
DL340		Same as DL260			
	1	Term. Strip, 13 Pin	16800-000	Cinch Jones	326-20-13-013

PARTS LIST

5.7 BACK PANEL ASSEMBLY

REF. NO.	QTY. USED	DESCRIPTION	DATAPULSE PART NO.	FEDERAL MFRS. CODE NO.	MFRS. PART NO.
5.7.1		Miscellaneous			
	1	Fuse-3A Fast Blo	15470-003	71400	AGC-3
	1	Transformer	24010-001	08742	15225

DATAPULSE
DIVISION OF DATAPULSE INCORPORATED

SERVICE BULLETIN NO. 1-65

SEMICONDUCTOR REPLACEMENTS

(Applicable to all Datapulse Models except the Model 100 and 102)

Datapulse makes extensive use of house labeled semiconductors, superseding or used in place of commercial equivalents. In most cases, these are procured against relaxed or actual commercial equivalent specifications, and commercial equivalents as listed below may, therefore, be used as replacements.

DATAPULSE TYPE NO.*	DATAPULSE PART NO.	COMMERCIAL EQUIVALENT
Diodes:		
DP16-0	22164-000	1N3600
DP16-1	22164-001	1N3604
DP19-0	22194-000	1N2070
DP19-1	22194-001	1N4002
DP19-6	22194-006	1N2071
Transistors:		
DP43-0	22435-000	2N984
DP46-0	22465-000	2N964A
DP46-1	22465-001	None**
DP59-0	22595-000	2N1132A
DP60-0	22605-000	2N2411
DP60-1	22605-001	None**
DP60-2	22605-002	2N2904 or 2N3133
DP60-3	22605-003	2N2894
DP60-4	22605-004	2N3209
DP60-5	22605-005	FT1702
DP60-6	22605-006	2N3640
DP63-0	22635-000	2N2369 or 2N2501
DP63-1	22635-001	None**
DP63-2	22635-002	None**
DP63-3	22635-003	2N2369A
DP63-4	22635-004	2N3646 3605 or ME 9021

*Some earlier publications show Type No. without the dash.

**
DP46-1 is selected from 2N2964A for high Beta.
DP60-1 is selected from 2N22894 for high V eco.
DP63-1 is selected from 2N2218 for second breakdown characteristics.
DP63-2 is selected from 2N914 for tighter Beta tolerance.

Replacements for these items should be procured from Datapulse.

1/1/66

DATAPULSE
DIVISION OF DATAPULSE INCORPORATED

APPLICATIONS BULLETIN

NO. 103-1

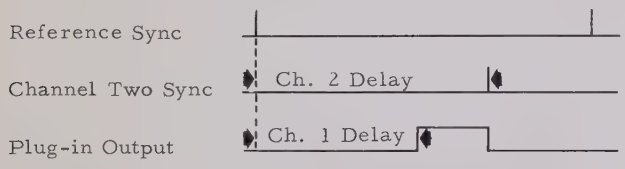
GENERATION OF WAVEFORM COMPLEMENT OUTPUTS USING MODEL 103 AND TWO TYPE P901, P902 OR P903 PLUG-INS

AND

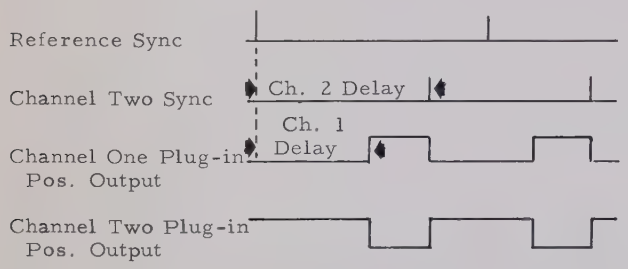
GENERATION OF TWO CHANNELS OF VARIABLY DELAYED TRIGGERS USING MODEL 103 AND ONE TYPE P904/2 PLUG-IN UNIT

The Type P901, P902, and P903 Plug-in Output Units provide an NRZ (non-return-to-zero) position on the pulse width control range switch. This function is designed primarily for use of these units in conjunction with the Model 200 or 202 Data Generators and is not useable with Model 103 or 103M instruments serialled 110 and under unless such units have been modified as indicated below.

In units with higher serials, one P901, P902, or P903 plug-in may be used, set for NRZ operation, to provide pulse outputs initiated by the Channel One delay and terminated by the Channel Two delay, providing typical outputs as follows:



Also, in units with higher serials, two P901, P902, or P903 plug-ins may be used, set for NRZ operation, to provide waveform complement outputs, typically as follows:



The recently announced Type P904/2 Plug-in Output Unit provides two channels of "trigger standardizing", designed to convert low power, low amplitude triggers (generated at the plug-in unit connectors in the Model 103 and similiar units) into higher power, fixed-width triggers for external use.

When used with any Model 103M instruments (Model 103 including power supply option M), each Type P904/2 plug-in provides, as Trigger Output A, a trigger pulse variably delayed by the basic instrument controls; no output occurs at Trigger Output B when used with Model 103M units serialled 110 and under unless such instruments have been modified as indicated below.

When used with higher serialled Model 103M instruments, plugged into either output channel, the Type P904/2 plug-in provides one Trigger Output delayed by the Model 103M Channel One delay controls and one Trigger Output delayed by the Channel Two delay controls.

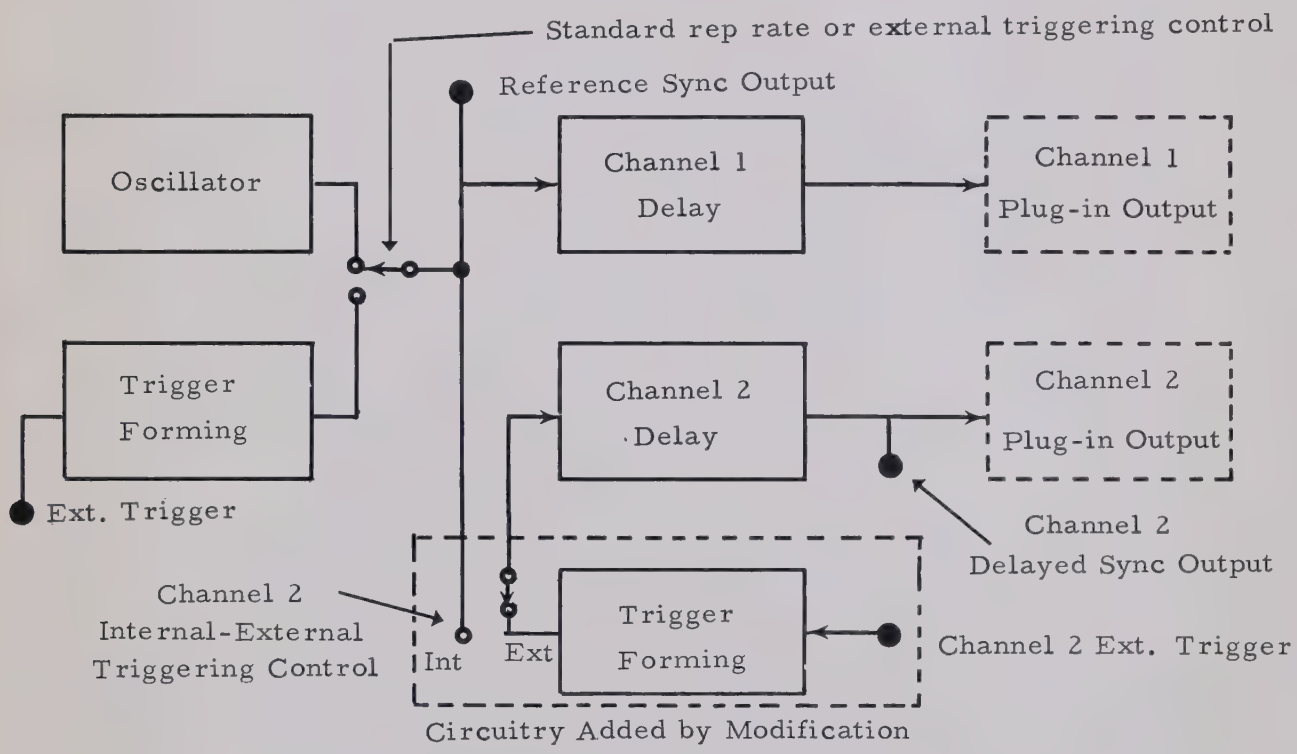
Earlier serialled Model 103M instruments may be retrofitted to provide performance as described above by 1) connecting together pins 17 and 18 of the Amphenol blue-ribbon connector for the Channel One plug-in and running a wire to pin 16 of the Channel Two connector, 2) similiarly connecting pins 17 and 18 of the Channel Two connector to pin 16 of the Channel One connector, and 3) reflecting this change in the instruction manual for the unit.

MODEL 103M-S1

(Model 103 Modified to Allow Independent Triggering of Channel 2)

The standard Model 103M Pulse Generator provides means for powering and triggering any two P900 Series plug-in output units with independently controlled delay, from an internal oscillator or a single external trigger. The modification described in this bulletin enables use of the instrument as a means for independent triggering of two plug-in output units.

SIMPLIFIED BLOCK DIAGRAM, MODEL 103M-S1



Block Diagram Description: In the standard unit, both delay channels are triggered from either the internal oscillator or from a single external trigger. In the modified unit the following options are available, selected by proper setting of the standard and added trigger source controls:

Mode	Channel 1 Trigger	Channel 2 Trigger
Internal Trigger	Internal Oscillator	Internal Oscillator
Single External Trigger	Main External Trigger	Main External Trigger
Separate External Triggers	Main External Trigger	Channel 2 External Trigger
Internal & External Triggers	Internal Oscillator	Channel 2 External Trigger

General: Specifications are identical to those of the standard Model 103M except as listed below.

Channel 2 Triggering: Channel 2 may be selected by panel toggle switch to trigger from the same source as Channel 1 (Internal Oscillator or Main External Trigger Input) or from the Channel 2 External Trigger Input.

Channel 2 External Trigger Input: Requires neg. pulse of at least 2v (10v max.), rise time approx. 20 nanosec., width at least 50 nanosec. Front panel BNC connector.

Price: Add $115.00 to Model 103M list price.

APPLICATIONS:

Pulse Standardizer and/or Two Channel Delayed Trigger Generator--used with one P904 Plug-in (providing ±5 or ±15v from approx. 50 ohms source, 50 nanosec., wide triggers from each channel), provides two completely independent delayed trigger outputs from external trigger inputs.

Single Pulse Generator and Delayed Trigger Generator--used with any P900 Series Plug-in in Channel 1, provides a fully controllable single pulse (externally or internally triggered) from Channel 1 plus the Channel 2 Delayed Sync Output, which may be initiated either by the Channel 1 trigger or by a separate external trigger.

Two Channel Pulse Generator--used with any two P900 Series Plug-ins, provides a fully controllable single pulse (externally or internally triggered) from Channel 1 plus a separately controlled single pulse from Channel 2, which may be initiated either by the Channel 1 trigger or by a separate external trigger.

To provide variable delay, amplitude and duration clock or bit sync outputs from Model 200M or 202M Data Generators, use unit as a Two Channel Pulse Generator as described above, externally triggering Channels 1 and 2 with the desired Data Generator Sync Outputs.

To provide variable delay data outputs from Model 200M Data Generator (not feasible for NRZ output), (1) remove plug-in output units from Model 200M and replace (in Channel 1) with one P904 Plug-in with both outputs set for neg. 5v output (which now provides programmed triggers for both Channels 1 and 2), (2) install in Model 103M-S1 the plug-ins removed from the Model 200M, (3) set the Model 103M-S1 Rep Rate control to "External" and the Channel 2 Triggering Control to "External", connect outputs of the P904 to the 103M-S1 External Input Jacks, (4) adjust 103M-S1 delay controls for desired delay from the Model 200M Clock Sync Output, adjust 103M-S1 plug-ins for desired data amplitude and duration.

DATAPUL[illegible] INC. — ENGINEERING ORDER — [illegible]UMBER

MODEL	EFFECTIVITY:	E.O.TYPE			NUMBER
103 202	IN PROD. AT THIS DATE / IN TESTING	DWG CHANGE			867
		E.C.R. 0144	R/W YES	PARTS MADE YES.	RELEASE DATE: MARCH 17 - 66
		OK TO USE		NOTED	E.O.BY: A.LARAMEE

S	DOCUMENT NUMBER	REV.	NOMENCLATURE/INSTRUCTIONS
A	J40 000 -019	A	SCHEMATIC. MULTIVIBRATOR. ETC. 1. CHANGE R229 FROM 2.2K. ½W. 10% TO 1K. ½W. 10%.
	L/M 37 000 - 055	A	TIMING CK'T BOARD ASS'Y. 2. CHANGE ITEM 10. QT'Y 13 ADD REF. DES. R 229 WAS QT'Y 12. 3. " " 24 " 5. DELETE " " R 229 " " 6.

APPROVALS

C. ENG'R	RE[illegible]	13 / 19 6
P. ENG'R	Dan[illegible]	3/19/6
PROD. MGR.	R[illegible]	3 19 66
MK'T	See per E.C.R.	13 18 '66
D & D	B[illegible]sich	18 APR 66
MANUAL CHANGE		YES

COPIES TO: QT'Y

LARAMEE	2
A.CREAMER	1

REFERENCE E.O.'S

REASONS & REMARKS: DELAY JITTER PROBLEM.

RELEASE E.O.

DATAPULSE
DIVISION OF DATAPULSE INCORPORATED

SEMICONDUCTOR REPLACEMENTS

(Applicable to all Datapulse Models except the Model 100 and 102)

Datapulse makes extensive use of house labeled semiconductors, superseding or used in place of commercial equivalents. In most cases, these are procured against relaxed or actual commercial equivalent specifications, and commercial equivalents as listed below may, therefore, be used as replacements.

DATAPULSE TYPE NO.*	DATAPULSE PART NO.	COMMERCIAL EQUIVALENT
Diodes:		
DP16-0	22164-000	1N3600
DP16-1	22164-001	1N3604
DP19-0	22194-000	1N2070
DP19-1	22194-001	1N4002
DP19-6	22194-006	1N2071
Transistors:		
DP43-0	22435-000	2N984
DP46-0	22465-000	2N964A
DP46-1	22465-001	None**
DP59-0	22595-000	2N1132A
DP60-0	22605-000	2N2411
DP60-1	22605-001	None**
DP60-2	22605-002	2N2904 or 2N3133
DP60-3	22605-003	2N2894
DP60-4	22605-004	2N3209
DP60-5	22605-005	FT1702
DP60-6	22605-006	2N3640
DP63-0	22635-000	2N2369 or 2N2501
DP63-1	22635-001	None**
DP63-2	22635-002	None**
DP63-3	22635-003	2N2369A
DP63-4	22635-004	2N3646 3605 or ME 9021

*Some earlier publications show Type No. without the dash.

**
DP46-1 is selected from 2N2964A for high Beta.
DP60-1 is selected from 2N22894 for high V eco.
DP63-1 is selected from 2N2218 for second breakdown characteristics.
DP63-2 is selected from 2N914 for tighter Beta tolerance.

Replacements for these items should be procured from Datapulse.

1/1/66

INSTRUCTION MANUAL

P905

PLUG-IN OUTPUT UNIT

The P905 Plug-in Output Unit is designed for use with DATAPULSE Model 200M, 103M, and 202M test instruments. The P905 features high power output pulses with independently variable, linear leading and trailing edge transition times, and pulse width variation from less than 50 nanosec. to 500 microsec.

This manual provides detailed instructions for the use and maintenance of your Model P905. A thorough understanding of its contents will contribute to full utilization and longer life of this unit.

DATAPULSE INCORPORATED
509 Hindry Avenue
Inglewood, California
ORchard 1-7713 ORegon 8-3983

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SECTION I

SPECIFICATIONS

1.1 INPUT TRIGGER (as provided by standard Models 103M, 202M, 200M*).

Negative 5 volt pulse, ac coupled, with a source impedance of less than 100 ohms; 10 nanoseconds rise time; 20 nanoseconds width; max. prf of 5 mc/s.

1.2 OUTPUT PULSES

Positive or negative provided, selectable by polarity switch, dc coupled with baseline at ground. Precaution must be taken when loading to other than ground, so as not to exceed the breakdown ratings of the output transistors.

1.2.1 Pulse Delay

Leading edge of the pulse output is delayed from the input trigger by approximately 50 nanoseconds (under minimum rise and fall time conditions).

1.2.2 Pulse Duration

Output pulse continuously variable from less than 50 nanoseconds to 500 microseconds in four decade ranges with vernier fill-in.

1.2.3 Amplitude

Continuously variable in two ranges from less than one volt to 30 volts when loaded with 50 ohms.

NOTE

1.2.4.1 Rise Time (with 50 ohm load) - Less than 20 nanosecond variable to 1 μsec, covered in two decade ranges controlling rise and fall simultaneously plus separate fill-in control within each range for rise and fall times.

1.2.4.2 Fall Time (with 50 ohm load) - Variable from typically 25 nsec (30 nsec max.) to 1 μsec.

For use with Type P905 Plug-in, Model 103M serials below 238, 200M serials below 052, and 202M serials below 047 require minor modification per Service Bulletin 200-1.

1.2.5 Waveform Aberrations (with properly connected 50 ohm load).

Overshoot, undershoot, ring and top slope are less than 5%(typically less than 2%) at amplitudes greater than 3 volts.

1.2.6 Duty Cycle

Circuitry limits pulse width duty cycle to 50%. Main instrument power supply limits useable duty cycle to 30% per plug-in if two plug-ins are used. No damage to plug-in or instrument will result if excessive duty cycles are set.

1.2.7 Output Protection

At duty cycles less than 20%, the unit will not be damaged by indefinite shorts to ground. With duty cycles greater than 20%, prolonged shorts to ground should be avoided. Back voltages up to 25 volts may be tolerated from other 50 ohm pulse sources, including direct mixing of output of two plug-ins.

1.3 POWER REQUIRED

46 volts dc at 700 ma for 50% duty cycle, 600 ma for 30% duty cycle. All power required is available from standard Datapulse instruments having the suffix M and using standard plug-in output units. (1.2 amps max. for two output units.)

1.4 CONSTRUCTION

Laminated front panel with black and red markings. Plugs into space provided in standard Datapulse instruments, mating with 24 contact Blue Ribbon connector. Front panel output connectors are BNC type. Size is 4 3/8" H x 4 3/4" W x 8 1/2" D. Weight is approximately 3 1/2 lbs.

1.5 ACCESSORIES

Furnished with one operation and maintenance manual section for insertion in basic instrument manual. Other accessories available at additional cost include extra manuals, coaxial cables, connector adapters, and Type 2002A, 15 watt, 50 ohm load.

SECTION II

OPERATING INSTRUCTIONS

2.1 DESCRIPTION OF CONTROLS AND CONNECTORS

2.1.1 Pulse Duration - μsec, Vernier

The black outer knob selects the width range. There are tive ranges, each covering one decade. The red inner knob provides continuous fill-in between ranges of the control. With this control fully counter-clockwise the instrument is calibrated at the width shown by the pulse width control.

2.1.2 Transition Time

2.1.2.1 Range: This control determines the range of the output pulse transition times. There are two ranges each covering approximately one decade.

2.1.2.2 Leading Edge: This control provides continuous variation of the leading edge transition time within the limits set by the transition time range control.

2.1.2.3 Trailing Edge: This control provides continuous variation of the trailing edge transition time within the limits set by the transition time range control.

2.1.3 Output

2.1.3.1 Amplitude: The potentiometric control acts as a vernier between the limits as set on the 3v-10v, 10v-30v switch.

2.1.3.2 Polarity: Positioning of this switch allows the output pulse to be either positive or negative.

2.1.3.3 Output 50 ohms: This BNC connector couples the variable parameter pulse to an external load.

CAUTION

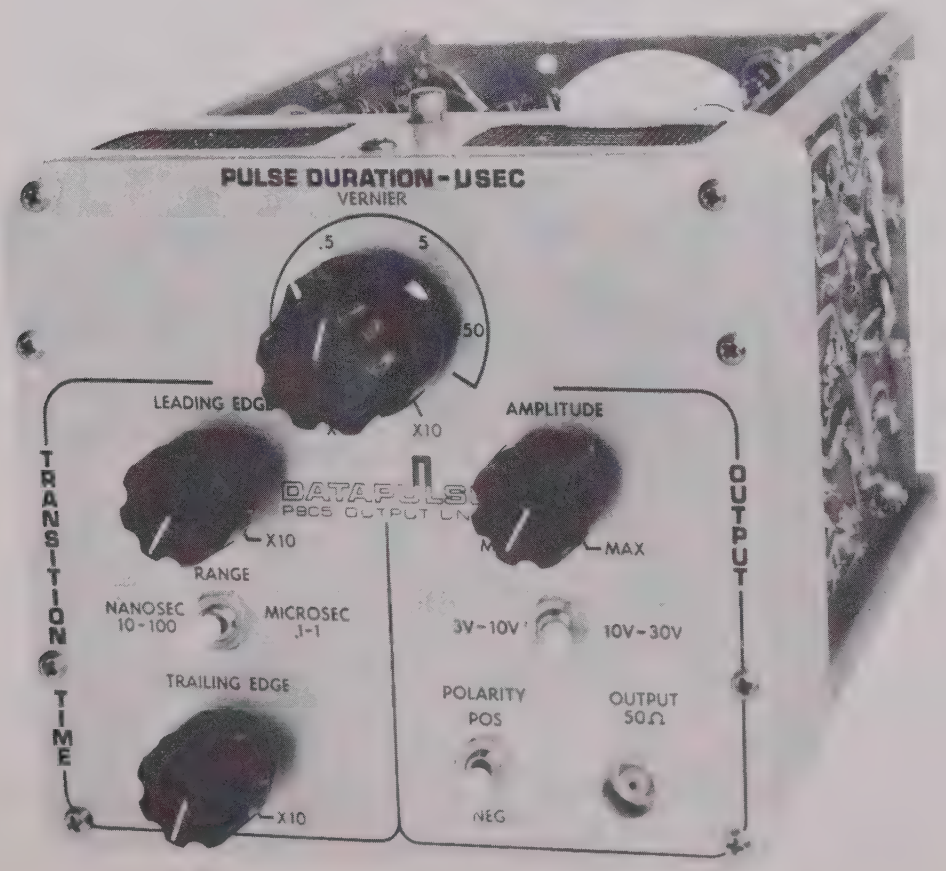
The high frequency transistors used for output amplifiers in this unit are limited as to maximum power dissipation.

High duty cycle operation accompanied by low resistive loads on the output may permanently damage the instrument (See paragraph 1.2.6).

2.2 PLACING IN OPERATION

Plug the P905 into its parent unit, pressing firmly to insure that the connectors make proper contact. Tighten the locking mechanisms. Connect the power cord to the rear of the instrument and to the power line and turn the unit POWER switch on.

Make sure the spacing of the input triggers to the P905 is not less than approximately five times the PULSE DURATION.



Observe the output pulse and vary the controls, observing their operation as explained in Paragraph 2.1.

If the P905 seems to be operating improperly, the troubleshooting section of this manual will be of considerable help in locating the trouble.

2.3 OPERATING CONSIDERATIONS AND SPECIAL APPLICATIONS

2.3.1 Mixing

When mixing the P905 output with other 50 ohm pulse sources, one should take care not to apply a back voltage of more than 25 volts. Low impedance voltage sources other than approximately ground should be avoided.

2.3.2 Transition Time Control

The P905 features an extremely versatile rise and decay time control. The leading and trailing edge transition times of the output pulse may be independently varied over a range of greater than 10:1. In addition, both edges are approximately linear. This feature virtually eliminates errors which usually creep in during setting up of rise and decay for a particular test, insuring repeatability of results and consistent data from test to test.

The transition time range control varies both the rise and decay times simultaneously in two steps from approximately 15 nsec to more than 1 μsec. The leading edge and trailing edge transition times are independent and provide continuous fill-in within a transition time range. With this form of control it is possible to produce waveforms with leading edge transition time differing from trailing edge transition time by a ratio of greater than 10:1, enabling the P905 to generate useful functions such as ramps, sawteeth, triangles and trapezoids, where required.

2.3.3 Loading Considerations

One of the major advantages of the P905 is its clean waveforms, even at minimum rise times. In order to preserve this degree of pulse fidelity, it is imperative that due consideration is given to loading. The generation of a clean waveform with rise times which are variable between the limits of 15 nsec and 1 μsec requires extremely refined circuit design and packaging technique. As such, it is necessary to restrict the type of loading which can be imposed upon the output pulse. Because of the wide usage of 50 ohm coaxial cables and accessories in industry, the P905 was designed for operation with a 50 ohm load.

The output section of the P905 consists of a current amplifier supplying 600 ma. The operating point of the amplifier is set so that the output transistors are near saturation when supplying 600 ma into a 50 ohm load. The load impedance must not vary more than ±5% from 50 ohms if the specified overshoot and undershoot specifications are to be met. Load impedances over 50 ohms cause saturation of the output transistors and hence, introduce storage time effects; on the other hand, load impedances less than 50 ohms increase the collector voltage of the transistors which causes overshoot and ringing. If the output is open circuited, the transistors will be in deep saturation and the resultant waveform will be extremely distorted.

2.3.4 Cabling Considerations

In most cases the P905 will be used to drive loads which are physically separated from it by several feet. In this case, it will be necessary to convey the signal by means of a 50 ohm transmission line. Preservation of low distortion waveforms is largely contingent upon the method of cabling and in proper termination of the transmission line. Clean waveforms are maintained by connecting the generator to its load with 50 ohm coaxial cable, and terminating the cable AT THE LOAD into 50 ohms.

2.3.5 Internal Waveshape Observation

CAUTION

ONE SHOULD NOT ATTEMPT TO VIEW INTERNAL WAVEFORMS EXCEPT WHEN THE POLARITY SWITCH IS IN THE NEG POSITION, AND UNDER NO CIRCUMSTANCES SHOULD AN OSCILLOSCOPE OR OTHER REFERENCE GROUND BE MADE TO THE INTERNAL CIRCUIT SIGNAL GROUND.

SECTION III

THEORY OF OPERATION

3.1 BLOCK DIAGRAM DESCRIPTION

An externally generated trigger is fed to the pulse width circuit via a pulse transformer. The width gate produced by the pulse width multivibrator is shaped into a variable rise and decay pulse by the transition time control circuit. This pulse is buffered and transformed into a current pulse by the output amplifier and is attenuated to the desired level by a constant impedance attenuator.

A positive output pulse is obtained essentially by grounding the output pulse and observing the signal ground as the output pulse. This technique involves the entire circuitry of the P905 back to the input pulse transformer.

CAUTION

When observing internal waveshapes, the polarity switch must be on NEG.

3.2 CIRCUIT DESCRIPTIONS

3.2.1 Pulse Duration Multivibrator

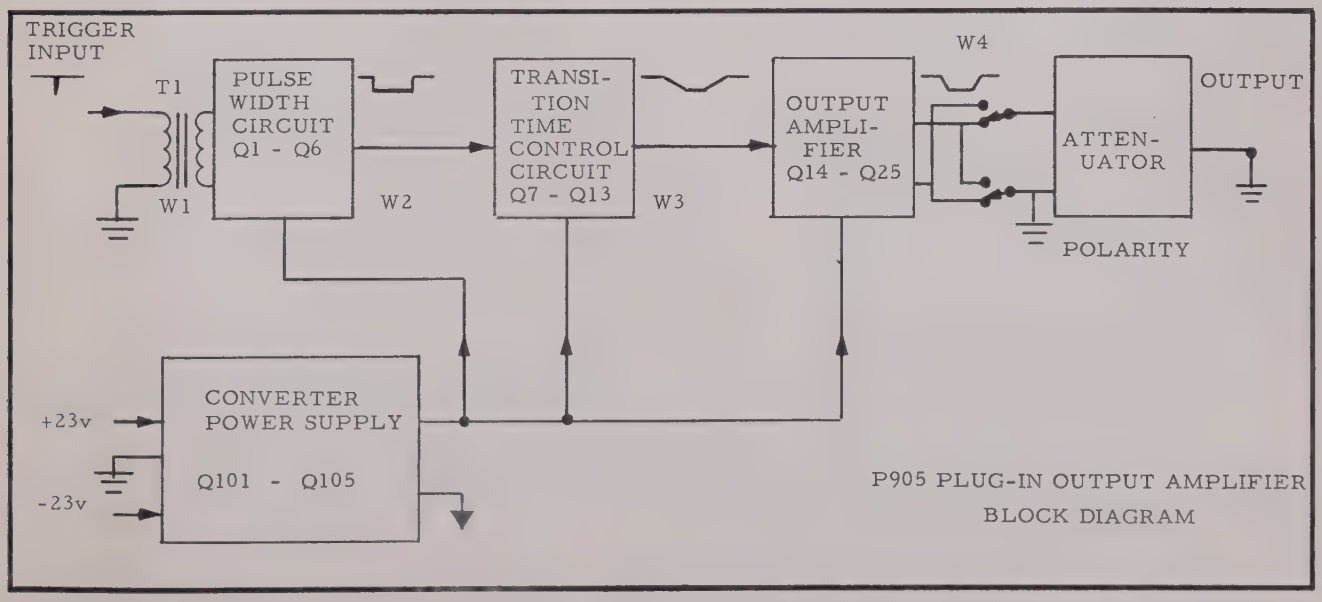
In the static state Q1 is held on by the bias developed across CR4 and CR6. The collector of Q1 is clamped at approx. -14v by CR5. Upon the application of a negative trigger at the base of Q1, it is turned off and its collector rises toward signal ground (▼), but is clamped at -10v by CR7. This positive step is emitter-follower coupled to the timing condenser by Q2, coupled across C_t and through emitter-followers Q3 and Q4 back to the emitter of Q1. C_t now begins to charge through the timing resistors toward -35v. When the voltage at the emitter of Q1 drops below its base voltage, Q1 again begins to conduct. The collector drops to -14v and C_t discharges through CR8 and the emitter resistor of Q2. The output is taken off the base of Q2 and amplified by Q5 and Q6 for presentation to the rise and fall time control circuit.

3.2.2 Transition Time Control Circuit

Transition time control is accomplished through controlled charge and discharge of known values of circuit capacity.

There are two sets of paraphase amplifiers, namely Q7, Q8 and Q9, Q10. In the set Q7, Q8 the base of Q7 is biased more positive than -13v by the input signal, while the base of Q8 is biased at approximately -14v by the drop across CR11. This causes Q7 to be cut off and Q8 to conduct. The signal at the collector of Q8 is clamped at approximately -15v by CR14. In the set composed of Q9 and Q10, the base of Q9 is biased at approximately -17v and the base of Q10 at approximately -18v. This biasing causes Q9 to conduct and Q10 to be cut off.

The negative pulse width gate is applied simultaneously to the base of Q7 and Q9 causing Q7 to conduct and Q9 to turn off. As Q7 turns on, Q8 turns off and as Q9 turns off, Q10 turns on. With Q10 on, the capacitor at its collector (C_t) begins to charge through Q10 and its emitter resistor. The current through Q10 is constant and determined by its emitter resistor, causing C_t to charge in a linear manner. The portion of the signal approximately below -21v will not pass through Q12 due to the emitter cut off action (this acts as the lower level clamp). At the end of pulse time the negative gate subsides allowing Q10 to turn off and Q8 to turn on. C_t now discharges through Q8 and its emitter resistor in a linear manner as previously described. The output is buffered and applied to the output amplifier for further amplification and application to the output connector.



P905 PLUG-IN OUTPUT AMPLIFIER BLOCK DIAGRAM

SECTION IV

MAINTENANCE INSTRUCTIONS

4.1 PREVENTIVE MAINTENANCE

4.1.1 Recalibration

The P905 contains stable circuitry and the unit will provide many hours of trouble free operation. To insure continued reliability, the power supply voltages and pulse width circuitry should be checked for calibration after each 500 hours of operation, or at least every six months if the unit is used intermittently.

4.1.2 Visual Inspection

Conduct visual inspections at regular intervals, preferably every few months. Check for possible circuit defects including loose or broken connections; scorched printed circuit boards, wires, or resistors; and loose nuts and bolts.

4.1.3 Component Replacement and Soldering Connections

When replacing transistors, diodes, or other heat-sensitive devices, a heat sink should be used between the device and the soldering iron tip. A pair of long-nosed pliers may be used in most cases. Special care must be taken, when soldering printed circuit wiring to avoid overheating and subsequent separation of the printed circuit from its epoxy material.

4.2 TROUBLESHOOTING PROCEDURE

The first points to check after most malfunctions are the power supply voltages.

The voltages used in the P905 must be adjusted in the following manner:

a) adjust the +23v and -23v supplies in the parent unit.

b) check for -40v and adjust the -35v supply (for convenience the output polarity switch should be set to NEG, this causes signal and chassis grounds to be the same dc potential).

c) adjust -15v so that it is 5v more negative than -10v (due to component tolerancing -10v may be anywhere between -9.8v and -12.2v).

d) check for -20v, ±5%.

Once it has been ascertained that the power supplies are functioning correctly, the most straightforward method of tracking down a trouble is to start at test point #1 and proceed through the instrument comparing the waveforms to those shown in Figure 4-1. (Set the polarity switch to NEG when observing these waveforms). Refer to Section III for circuit descriptions.

4.3 CALIBRATION PROCEDURE

4.3.1 General

Allow five minutes warm-up before commencing calibration. During this period, make sure that the instrument is working properly. If any portion of the module fails to calibrate, repair should be effected before attempting to complete calibration.

4.3.2 Equipment Required

a) a dc voltmeter with an accuracy of 3% from 10v to 50v, 20,000 ohms/v sensitivity.

b) a general purpose dc oscilloscope with at least 30 mc band-pass.

4.3.3 Power Supply

a) check for proper adjustment of +23v and -23v supplies in the parent unit with which the P905 is used.

b) set the output polarity switch to NEG and use the chassis ground as a reference. Observe the potential between the -35v test point and ground; adjust to -35v with the -35v adj potentiometer.

c) measure the -10v potential and adjust the -15v supply with the -15v adj potentiometer so it is 5v more negative than the -10v supply.

4.3.4 Waveshape Calibration (Output Pulse)

a) Observe the negative output pulse (properly terminated).

Settings:
PULSE DURATION--.05 μsec, Vern. cw
TRANSITION TIME--Leading edge, ccw; Trailing edge, cw; Range, 20-100 nsec
AMPLITUDE-- cw, 10-30v; Scope Settings, 10v/cm, .1 μsec/cm

b) Adjust the waveshape calibration control (abbreviated WS on pc board) until the notch at the beginning of the trailing edge of the pulse is minimum with no leading edge pulse overshoot (see Fig. 4.2). If the pulse amplitude is other than 30v, adjustment of the AMP CAL control should be made. If amplitude is below spec, the WS control must be backed off to allow for an increase in amplitude, then readjusted for waveshape.

4.3.5 Pulse Duration--μsec (set the output pulse polarity to POS)

On the pulse duration switch there are three potentiometer controls labeled .5 μsec Lower Limit, .5 μsec Upper Limit, and .05 μsec Lower Limit.

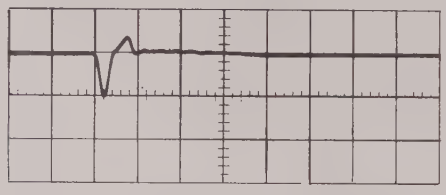
4.3.5 (cont'd.)

Set rise and fall times at minimum. Set delay to minimum. Maintain repetition rate to within nominal duty cycle limitations. Monitor Positive pulse on Tektronix 541 (equivalent items may be used).

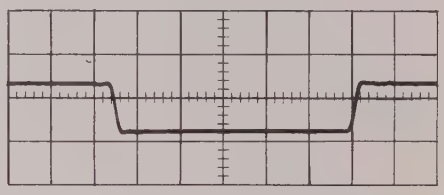
Set pulse duration control to 50 μsec range (vernier fully cw). Adjust 0.5 Upper Limit Potentiometer to 0.5 Msec. Set pulse duration control to 0.05 μsec range (vernier fully ccw). Adjust 0.05 Lower Limit Potentiometer to 50 nsec. (Use Sampling Scope) Set vernier at this range fully cw. Adjust C-10 trimmer to 0.55 μsec. (Readjustment of 0.05 Lower Limit Potentiometer may be necessary. Set pulse duration control to 0.5 μsec position (Vernier fully ccw). Adjust 0.5 Lower Limit Potentiometer to 0.45 μsec.

Approximately 20% overlap should be seen with these settings. Readjustments may also be necessary when plug-in adaptor is removed from extender and mounted directly to unit.

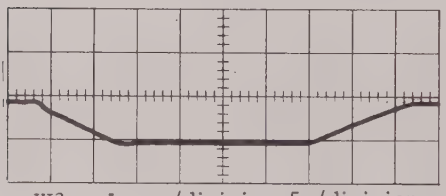
This concludes the P905 calibration.



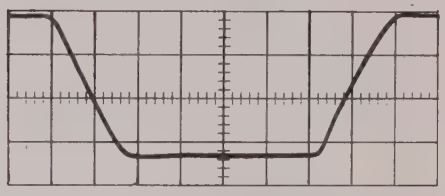
W1: .1μsec/division, 5v/division



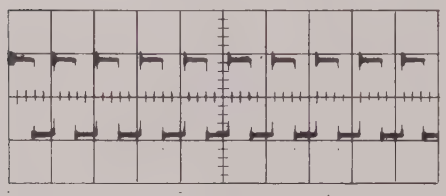
W2: .1μsec/division, 5v/division



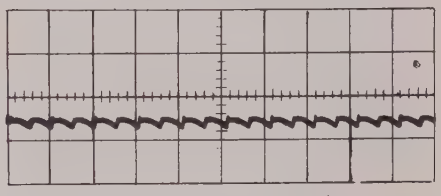
W3: .1μsec/division, 5v/division



W4: .1μsec/division, 10v/division

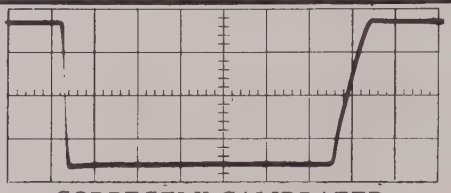


W5: 50v/cm, 1 millisec/cm

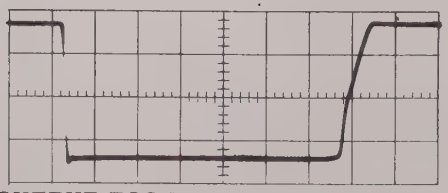


W6: 0.5v/cm, 1 millisec/cm

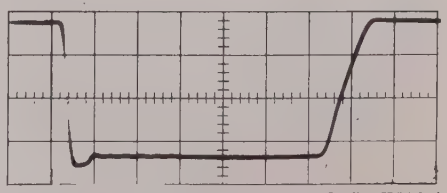
FIGURE 4-1: The following settings were used to obtain Waveforms W1 through W6: Pulse Duration: .05μsec range, vernier X10. Transition Time: 20--100 nsec range, leading & trailing edge X10. Amplitude: 10--30v range, amplitude max. Polarity: Neg. with output pulse properly terminated.



CORRECTLY CALIBRATED
.1 μsec/division, 10v/division



OUTPUT TOO FAR INTO SATURATION
(Trailing Edge Notch Apparent)
.1μsec/division, 10v/division



OUTPUT NOT NEAR ENOUGH TO SATURATION
(too much overshoot & ringing)
.1μsec/division, 10v/division

FIG. 4.2, WAVESHAPE CALIBRATION

4.4 SPECIFICATION VERIFICATION

The following equipment or its equivalent is necessary:

a) A 5 mc trigger source with ±23v at the required currents (Datapulse Model 202M or 103M.) Datapulse Model 200M is not capable of testing the 5mc operation, but may be used with this limitation in mind.

b) Syncroscope (Tektronix type 543 with type L single trace preamplifier).

c) Sampling Scope (Tektronix Type 661)

IT IS ASSUMED THAT THE INSTRUMENT WITH WHICH THE P905 IS BEING USED FULLY MEETS THE REQUIRED SPECIFICATIONS AS TO POWER SUPPLY VOLTAGES AND TRIGGER INPUT WAVESHAPE.

4.4.1 Pulse Duration

Plug the P905 into one of the receptacles provided in its parent unit.

Set CLOCK (REPETITION) RATE to 0.1 MC/S, VERNIER cw.

Throw all program switches (200 or 202) to the up position.

Set PULSE DELAY to minimum (on parent unit).

Set PULSE DURATION to .05 μsec and Vernier ccw.

Set other P905 controls as follows:

CONTROL	SETTING
LEADING EDGE	Fully ccw (X1)
RANGE	20-100 nsec
TRAILING EDGE	Fully ccw (X1)
AMPLITUDE	Fully cw (MAX)
3V-10V, 10V-30V	10V-30V
POLARITY	NEG

Load the output with 50 ohms (See sect. 2.3.3 for loading considerations).

Turn the instrument on and allow 5 minutes warm-up period.

Set scope sweep speed to .1 μsec/cm, vertical sensitivity 10v/cm.

Sync scope from Clock (Reference) sync output.

View the pulse output.

See pulse duration settings Table 4-1.

4.4.2 Pulse Amplitude

With instrument and scope settings as in the final step of the Pulse Duration Calibration Check, verify a pulse amplitude of at least 30 volts. Throw the 3v-10v, 10v-30v switch to 3v-10v. Verify a pulse amplitude of approx 10v (±1v). Verify that the pulse amplitude decreases to less than one volt when the AMPLITUDE control is rotated fully CCW.

4.4.3 Leading and Trailing Edge Transition Times And Pulse Fidelity Check

Set Scope Sweep speed to .1 μsec/cm.

Set Pulse Duration to .5 μsec X1.

Set Repetition Rate to 10 KC/sec.

Set Transition Time Range Switch to 20-100 nsec.

Set Leading Edge and Trailing Edge Controls fully CW (X10).

Verify rise and decay times of pulses to be greater than .1 μsec.

Set Scope Sweep speed to 1 μsec/cm.

Set Pulse Duration to 5 μsec X10.

Set Transition Time Range switch to .1-1 μsec.

Verify rise and decay times of pulse to be greater than 1 μsec.

Set Leading Edge and Trailing Edge Controls fully CCW (X1).

Set Pulse Duration to .5 μsec X1.

Set Scope Sweep Speed to .1 μsec/cm.

Verify that the rise and decay times are less than they were when the controls were set on 20-100 nsec and X10 above.

Observe Pulse on Sampling Scope .

Set Sweep speed to 50 nsec/cm.

TABLE 4-1

PULSE DURATION CALIBRATION CHECK

Clock Rate (Rep. Rate)	Pulse Duration	Vernier	Scope Sweep Speed(per CM)	Correct Pulse Duration[1](CM)	Tolerance (CM)
.1 mc/s	.05μsec	CCW	.02μs (.1, mag X5)	2.5 or less	±.5
.1 mc/s	.05 μsec	CW	.1 μsec	5	±.5
10 kc/s	.5 μsec	CCW	.1 μsec	5	±.5
10 kc/s	.5 μsec	CW	1.0 μsec	5	±.5
1 kc/s	5 μsec	CCW	1.0 μsec	5	±.5
1 kc/s	5 μsec	CW	10 μsec	5	±.5
.1 kc/s	50 μsec	CCW	10 μsec	5	±.5
.1 kc/s	50 μsec	CW	.1 millisec	5	±.5

1. Pulse duration is measured from the 50% amplitude point on the leading edge of the pulse to the 50% amplitude point on the trailing edge of the pulse.

4.4.3 (Con'd)

Set Transition Time Range Switch on 20-100 nsec.

Set Leading & Trailing Edge Controls CCW (X1).

Set Pulse Duration Switch on .05 μsec and adjust vernier control for a 5 cm wide pulse.

Using an appropriate multiplier on scope sweep speed, verify that the leading edge transition time is less than 20 nsec and that the trailing edge transition time is less than 30 nsec.

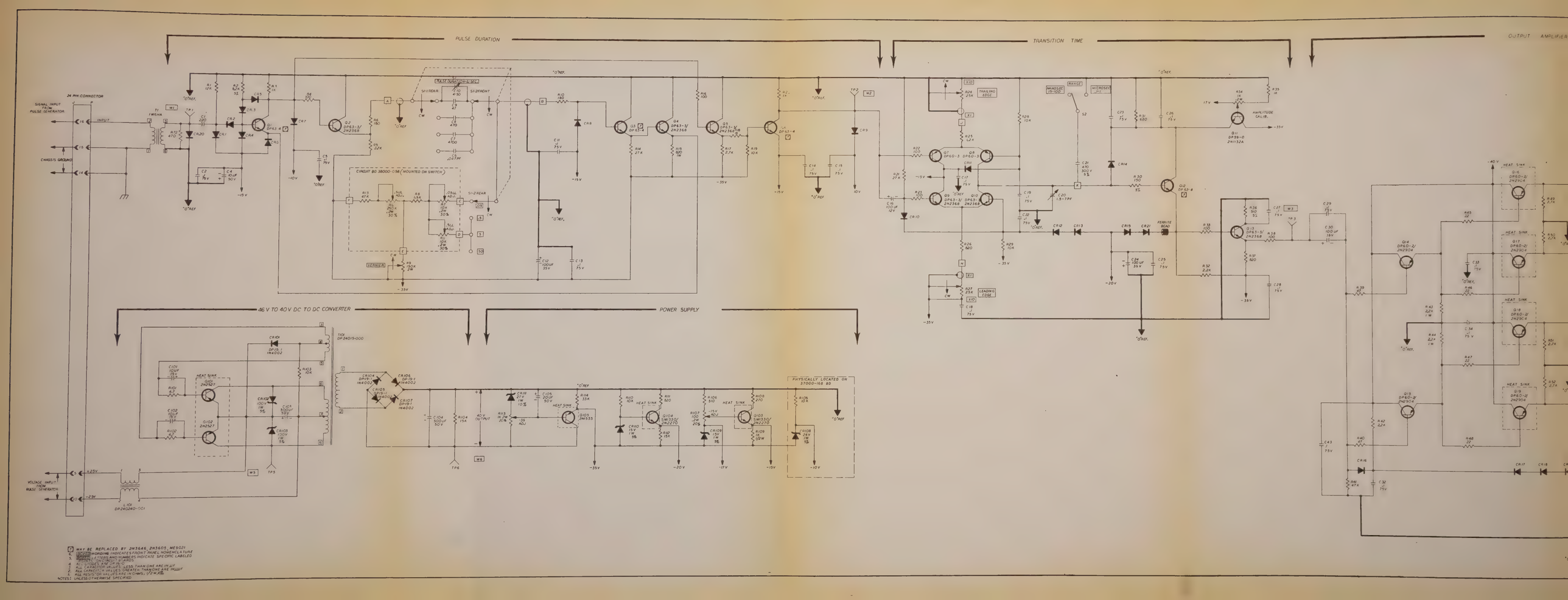
Switch Pulse Polarity to POS.

Verify pulse aberrations being less than ±5% of total pulse amplitude.

Switch Pulse Polarity to NEG.

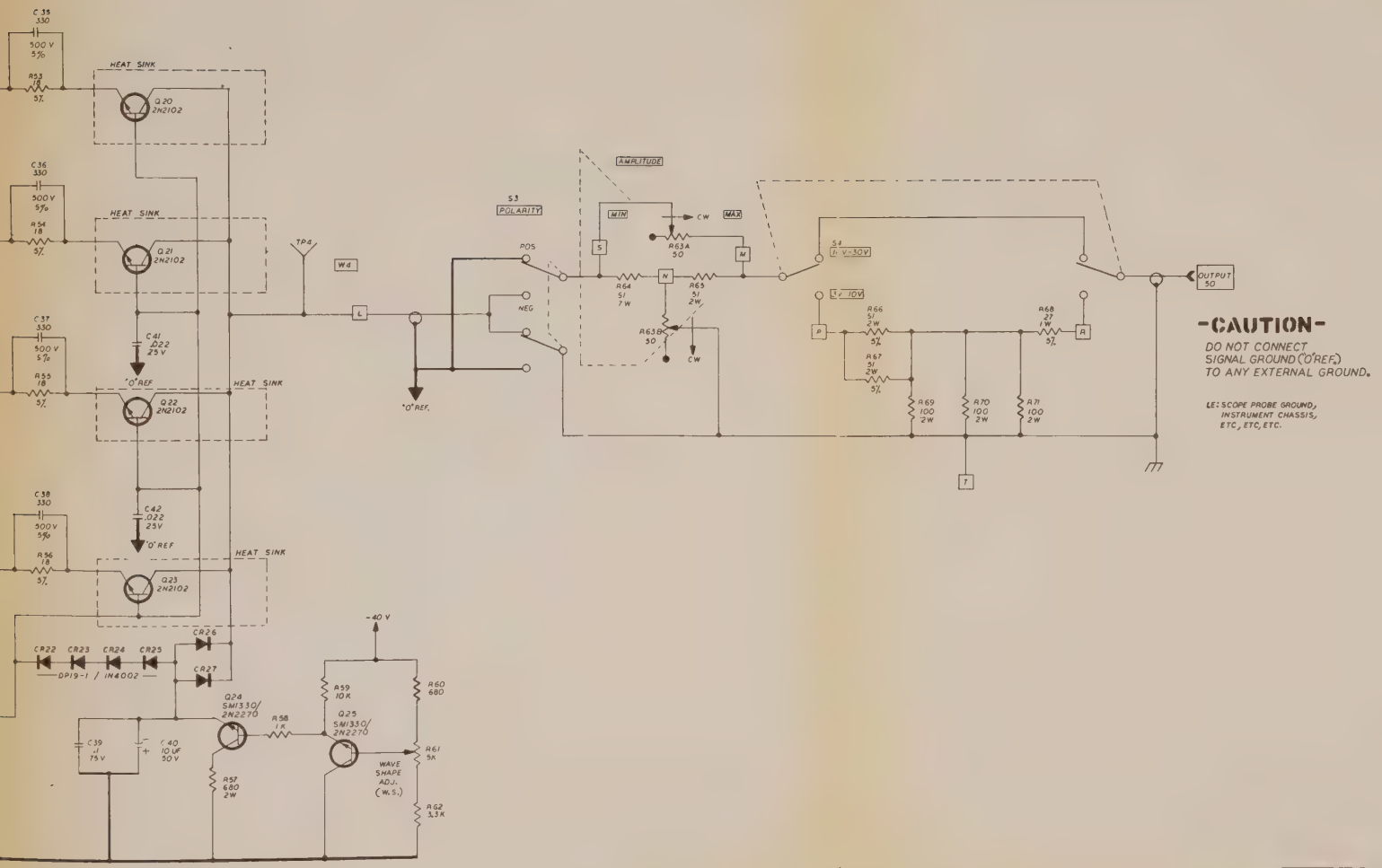
Verify pulse aberrations being less than ±5% of total pulse amplitude.

This concludes the Specification Verification Check.



1. ◇ MAY BE REPLACED BY 2N3646, 2N3605, MES021
2. ⟨0⟩ WORKING INDICATES FRONT PANEL NOMENCLATURE
3. (A) LETTERS AND NUMBERS INDICATE SPECIFIC LABELED CONTROLS, SWITCHES & JACKS
4. ALL DIODES ARE 1N4002 UNLESS THAN ONE ARE IN CKT
5. ALL CAPACITOR VALUES GREATER THAN ONE ARE IN μμF
6. ALL RESISTOR VALUES ARE IN OHMS, 1/2 W, 5%

NOTES: UNLESS OTHERWISE SPECIFIED



-CAUTION-

DO NOT CONNECT SIGNAL GROUND ("0" REF.) TO ANY EXTERNAL GROUND.

LE: SCOPE PROBE GROUND, INSTRUMENT CHASSIS, ETC., ETC., ETC.

REFERENCE DESIGNATIONS		
C1	C 105	C 3, 31, 44-100
CR 1	CR 111	CR 28-100
R1	R 114	R 72-100
G1	Q 105	Q 26 - 100
FIRST USED	LAST USED	OMITTED

REVISIONS				
LTR	ECN	DESCRIPTION	DATE	APPROVED
		SEE EO J40000-051		

DRAWN	G. BARTLEIN	4-1-68	
ENGINEER			
APPROVED			
EO 1077			

SCHEMATIC — OUTPUT UNIT P 905

DATAPULSE INC. MALIBU, CALIFORNIA

J 40000-051

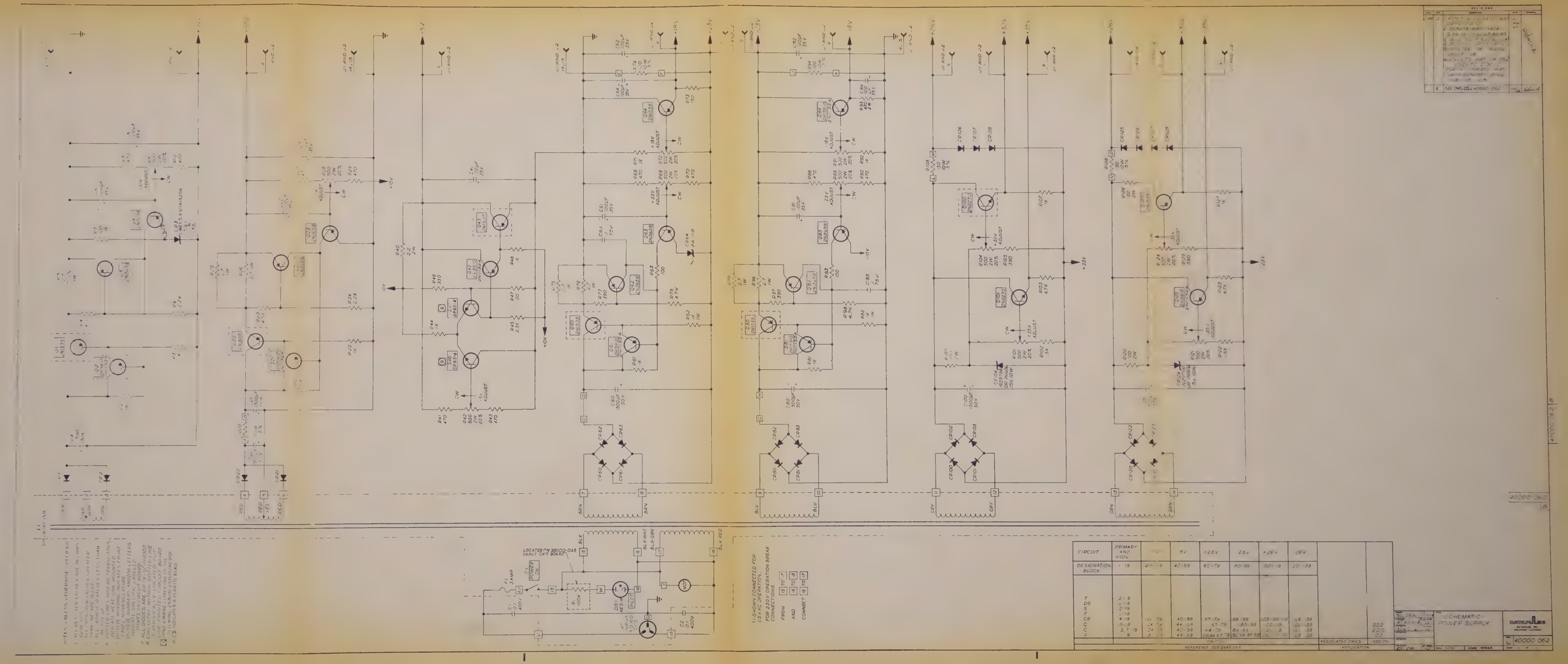
SHEET 1 OF 1

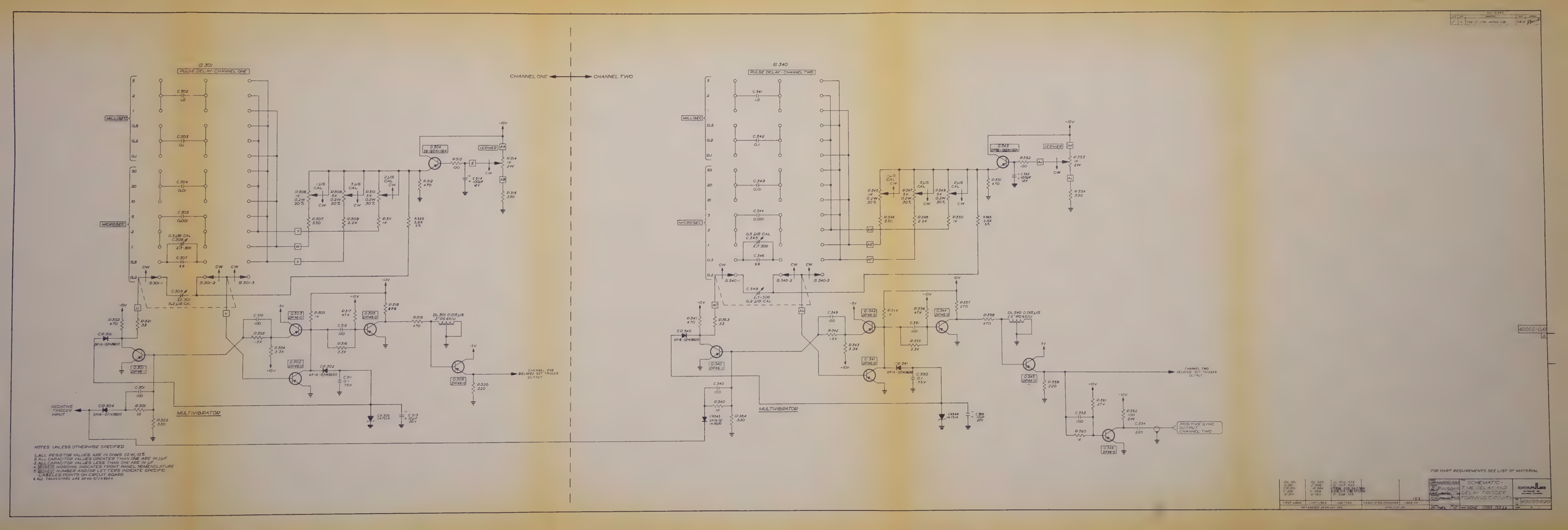
J40000-051

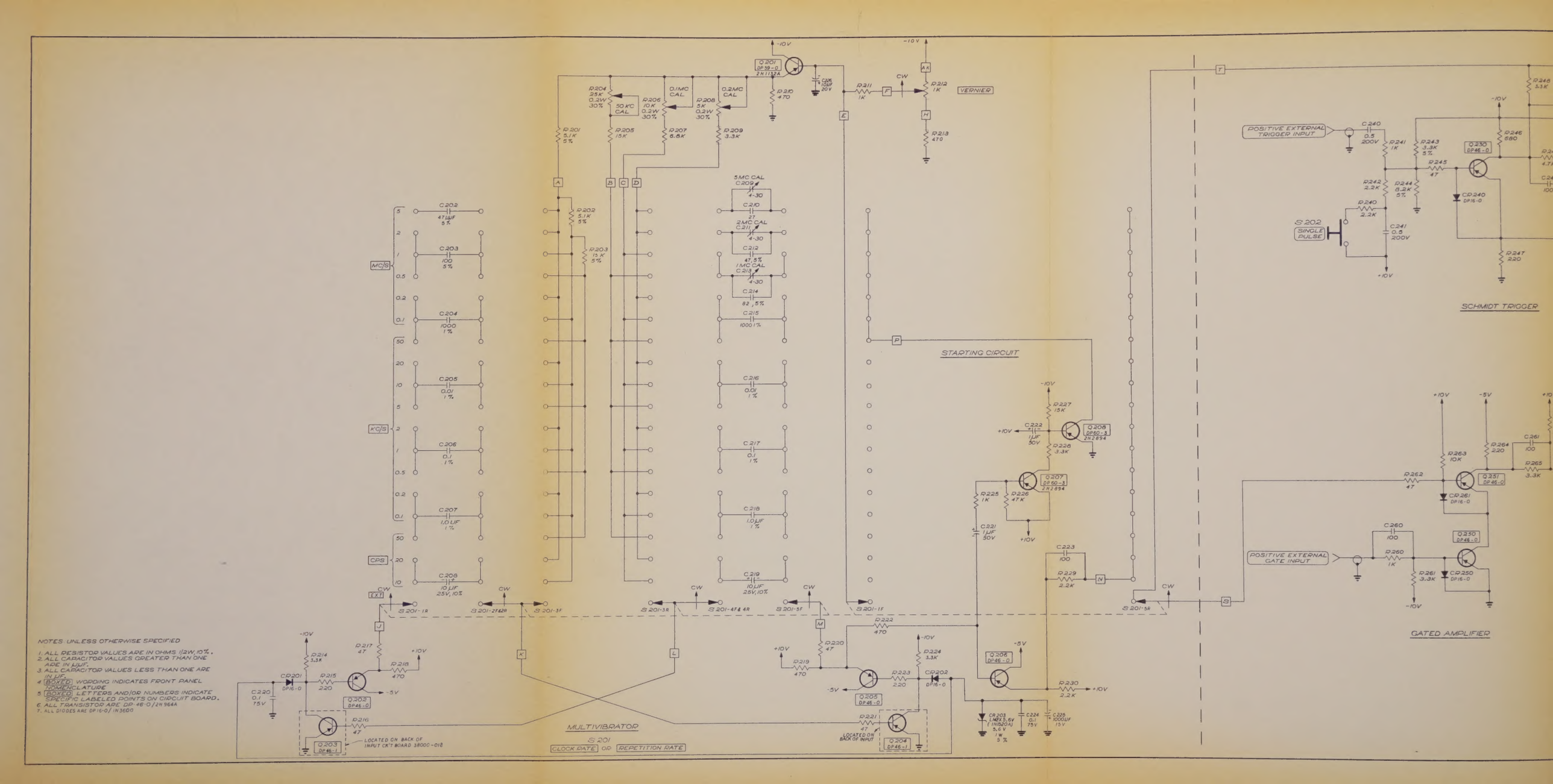
ADDENDA AND ERRATA
Datapulse Model P905
Plug-In Output Unit

E.O. NO.	EFFECTIVE DATE	DWG. NO.	CHANGE
845	2/17/66	J40000-051A	Schematic Power Supply Section. 1. Change R107 to read 250 Ω. 2w (-15v Adjust), was 100 Ω.

Revised 2/17/66


NOTES: UNLESS OTHERWISE SPECIFIED
1. ALL RESISTORS ARE 1/4W 5%
2. ALL CAPACITORS ARE 50V
3. ALL ADJUSTABLES ARE TOP MOUNTED
4. DOTTED LINES AROUND TRANSISTORS, DIODES AND INTEGRATED CIRCUITS INDICATE HEAT SINK MOUNTED
5. ALL ADJUSTABLES ARE SET AT FACTORY
6. FRAME NOMENCLATURE
INDICATES SPLICE - MUST LETTERS
INDICATES SPLICE - NUMBERS
INDICATES ON CIRCUIT BOARD
7. ALL CIRCUITS WITHIN DOTTED LINE ARE ON CIRCUIT BOARD
8. CIRCUITS WITHIN DOTTED LINE ARE ON SIDE FRONT PANEL CIRCUIT BOARD
INDICATES WIRE NUMBER
INDICATES A FERRITE BEAD
T1 SHOWN CONNECTED FOR 115 VAC OPERATION.
FOR 230 VAC OPERATION BREAK CONNECTIONS
FROM 5 TO 7, 6 TO 8
AND 6 TO 8
CONNECT 5 TO 7
LOCATED ON 30000-043 INPUT CKT BOARD
F1 3 AMP
S1 POWER
C1 .01 400V
C2 .01 400V
C3 .01 400V
T1
BLK
BLK-WHT
BLK-GRN
BLK-RED
+5V
+10V
+15V
+23V
-5V
-10V
-15V
-23V
+5V ADJUST
+10V ADJUST
+15V ADJUST
+23V ADJUST
-5V ADJUST
-10V ADJUST
-15V ADJUST
-23V ADJUST
CIRCUIT
PRIMARY AND +10V
+5V
+23V
-23V
+15V
-15V
DESIGNATION BLOCK
1-19
20-39
40-59
60-79
80-99
100-119
120-139
REVISIONS
SCHEMATIC POWER SUPPLY
DATAPULSE
40000 062
SEE DWG. 40000-062


S 301
PULSE DELAY - CHANNEL ONE
S 340
PULSE DELAY - CHANNEL TWO
CHANNEL ONE
CHANNEL TWO
MILLISEC
MICROSEC
MULTIVIBRATOR
NEGATIVE TRIGGER INPUT
CHANNEL ONE DELAYED SET TRIGGER OUTPUT
CHANNEL TWO DELAYED SET TRIGGER OUTPUT
POSITIVE SYNC OUTPUT CHANNEL TWO
NOTES UNLESS OTHERWISE SPECIFIED
1 ALL RESISTOR VALUES ARE IN OHMS 1/2 W, 10%
2 ALL CAPACITOR VALUES GREATER THAN ONE ARE IN U.F.
3 ALL CAPACITOR VALUES LESS THAN ONE ARE IN U.F.
4 BOXED WORDING INDICATES FRONT PANEL NOMENCLATURE
5 BOXED NUMBER AND/OR LETTERS INDICATE SPECIFIC LABELED POINTS ON CIRCUIT BOARD
6 ALL TRANSISTORS ARE DP 46-D/2N3644
FOR PART REQUIREMENTS SEE LIST OF MATERIAL
SCHEMATIC - TIME DELAY AND DELAY TRIGGER FORMING CIRCUIT
40009020



NOTES UNLESS OTHERWISE SPECIFIED

1. ALL RESISTOR VALUES ARE IN OHMS 1/2W, 10%.
2. ALL CAPACITOR VALUES GREATER THAN ONE ARE IN µµF.
3. ALL CAPACITOR VALUES LESS THAN ONE ARE IN µF.
4. BOXED WORDING INDICATES FRONT PANEL NOMENCLATURE
5. BOXED LETTERS AND/OR NUMBERS INDICATE SPECIFIC LABELED POINTS ON CIRCUIT BOARD.
6. ALL TRANSISTOR ARE DP-46-0/2N 964A
7. ALL DIODES ARE DP16-0/ IN3600

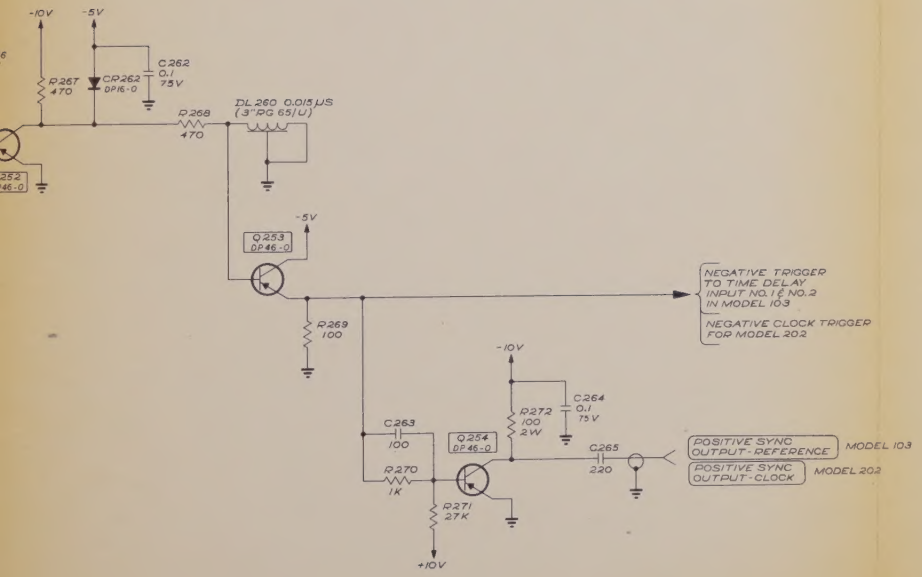
REVISIONS				
ECA	DWG	DESCRIPTION	DATE	APPROVAL
---	A	SEE DWG. EO J40000-019	9/20/67	B Brink

C242
100

R251
470

Q231
DP46-0

R250
10K



40000-019
A

FOR PART REQUIREMENTS SEE L/M

DL260	DL260	S203-UP		202
Q201	S202	Q209,229,232-249		103
Q201	Q254	CR204-39,241-59		
CR201	CR262	C201,227-38,244-59		
C202	C265	R231-39,252-59		
R201	R272			
FIRST USED	LAST USED	OMITTED	ASSOCIATED DRAWINGS	USED ON
REFERENCE DESIGNATIONS			APPLICATION	

DRAWN	C.DANADOS	9/19/67
CHECKED	B Brink	9/20/67
ENGINEER		
APPROVED		
RELEASED	EO 1082	

NEXT ASSY

TITLE: SCHEMATIC - MULTIVIBRATOR, INPUT CIRCUITRY & TRIGGER FORMING CIRCUIT

FINISH: NONE CODE: 12933

DATAPULSE INC. MALIBU, CALIFORNIA

SIZE: J 40000-019

SHEET 1 OF 1

WARRANTY

Datapulse Incorporated warrants each instrument of its manufacture to be free from defects in material and workmanship. Our obligation under this Warranty is limited to servicing or adjusting any instrument returned to our factory for that purpose, and to making good at our factory any part or parts thereof except tubes, transistors, fuses or batteries which shall, within one year after making delivery to the original purchaser, be returned to us with transportation charges prepaid, and which our examination shall disclose to our satisfaction to have been thus defective.

Instruments returned under this Warranty will not be accepted at the Datapulse plant without prior authorization by a Datapulse representative or by the service manager of Datapulse Incorporated.

Datapulse Incorporated reserves the right to make changes in design at any time without incurring any obligation to install same on units previously purchased.

This Warranty is expressly in lieu of all other obligations or liabilities on the part of Datapulse Incorporated and Datapulse Incorporated neither assumes nor authorizes anv other person to assume for them any other liability in connection with the sales of Datapulse Incorporated instruments.

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